Productivity Booklet

7QC Basic Level

NPO PAKISTAN

7 QC Tools
(Basic Level)

National Productivity Organization (NPO) working under the umbrella of Ministry of Industries and Production is mandated to promote productivity to become locally and globally competitive.

Vision: “Economically Productive and Globally Competitive Pakistan”

Mission: “To enhance total factor productivity (TFP) through human resource development (HRD), technology demonstration and improved practices, processes and procedures by 2030”

NPO is working as a Liaison Office of Asian Productivity Organization (APO) which represents 21 Asian Countries with the mandate to promote productivity and quality consciousness among the public and private sector organization.

NPO Pakistan intends to launch “National Productivity Movement in Pakistan for Sustainable National Productivity” and to promote productivity culture in Public and Private sector Organization by creating awareness through training, seminars, workshops.

This booklet will serve the purpose of creating awareness among general public, academia, industrial, agricultural and service sector.

ACKNOWLEDGEMENT

This work has been produced by the dedicated team of the National Productivity Organization which is committed to enhance productivity in Pakistan by introducing various productivity tools in small, medium and large scale enterprises through training, seminars, workshops, consultancy, release of index surveys, qualification certification, promotion of a comprehensive understanding of energy and the environment for raising productivity.

It is of the great importance to highlight and appreciate the role, commitment and support of Ministry of Industries and Production, and NPO Board in order to develop this useful product.

NPO would like to express its appreciation to all contributors and editors for their dedicated work, input and perseverance in finalizing this courseware.

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"I believe this will be useful for organizations and its people to gain the knowledge and ability to solve problems and improve productivity at the workplace".

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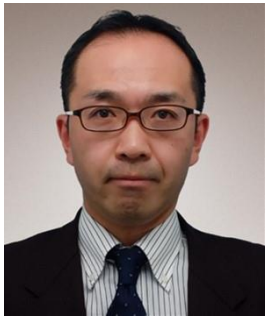

"This mentions the importance of the problem identification and analysis. I found a lot of enterprises who started 5S or applying 7QC tools, but not a few of them gave up due to lack of sustainability"

Alex Yap

Senior Consultant

Ecolean Consultancy Sdn. Bhd., Malaysia.

"I had reviewed and no additional comments."

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"I believe these will be very useful and powerful for the Productivity and Quality improvement"

Note: This booklet has been prepared from already endorsed 7QC Curriculum by experts

KEY CONTENTS

1. Learning Objectives
2. Introduction to Productivity
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   - Impact of Productivity
   - Productivity Concept & 7QC
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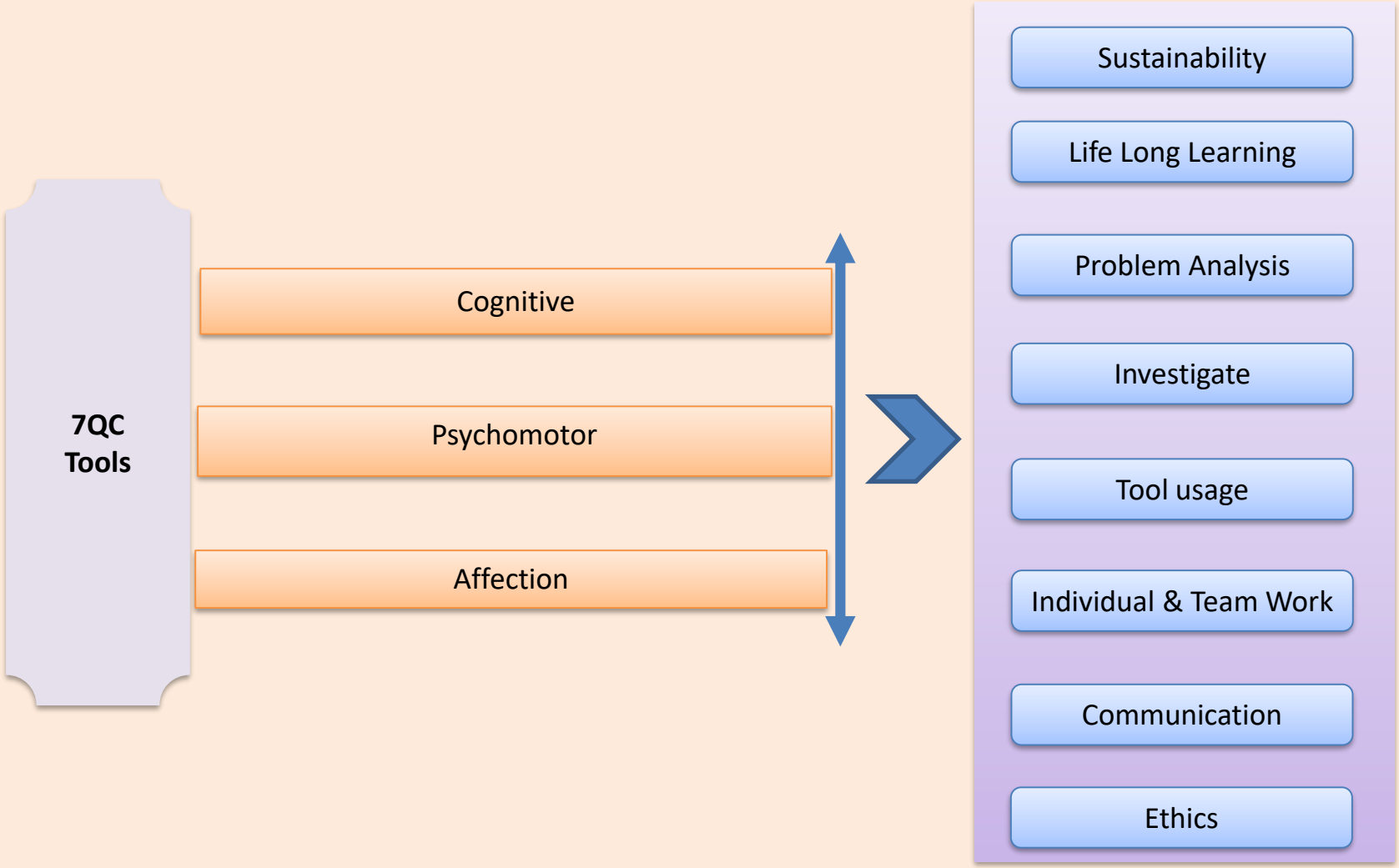
   - Check Sheets
   - Pareto Diagram
   - Scatter Diagram
   - Cause and Effect
   - Control Charts and Graphs
   - Histogram

BOOKLET LEARNING OBJECTIVES

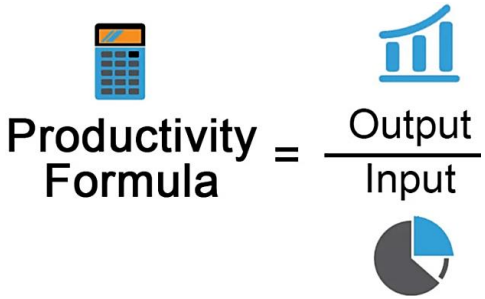
Training on Japanese Management Practices

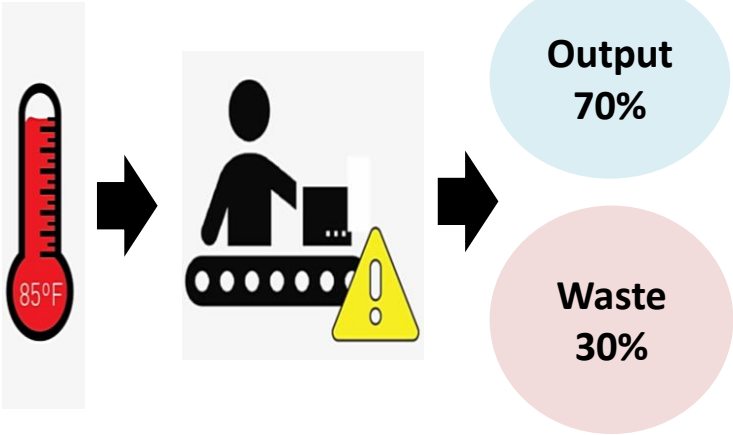


Introduction to Productivity

What is Productivity

"Productivity is a measure of your effectiveness in the workplace with a focus on the quality and quantity of the output."





Pinterest

Productivity Measurement

1. Single Factor Productivity(SFP):

SFP is a measure of output against specific input. Its significance lies in its focus on the utilization of one resource such as labor, machine or others.

$$Single\ Factor\ Productivity = \frac{Output}{Specific\ Input}$$

$$Labor\ Productivity = \frac{Output}{Labor\ Input}$$

$$Machine\ Productivity = \frac{Output}{Machine\ Input}$$

$$Capital\ Productivity = \frac{Output}{Capital\ Input}$$

2. Multi Factor Productivity(SFP):

Multifactor productivity is the ratio of total output to the number of inputs (labor, energy and material) required for that specific output.

$$Multi\ Factor\ Productivity = \frac{Output}{Labor+Machine+Energy}$$

Importance of Productivity

Ref: Legatum Prosperity Index

Sustainable National Productivity

Sustainable National Productivity

1st National Productivity Movement of Pakistan

Sustainable National Productivity (SNP)

AIM

"Create awareness on the use of Modern innovative techniques, tools and technology"

IMPACT

- Develop Positive Attitude.
- Educate Public, Workers, Students.
- Positive Impact on Productivity of Pakistan.
- Promotes Culture of Respect, Understanding, and Acceptability.

1st Productivity Movement of Pakistan

The Aspiration……

There is a need for awareness on productivity in Pakistan at all levels, including industry, agriculture, academia, and the general public.

The National Productivity Organization (NPO) has launched "National Productivity Movement" in a bid to create awareness on the use of modern innovative techniques and technology in various sectors of the country's economy for the promotion of sustainable productivity.

Productivity Movement Across the World

1. Singapore Productivity Movement - Launched in 1981 lead by the PM Lee Kaun.
2. Malaysian Prime Minister - Launched in 1985 and PM chairs the Quarterly Review Meetings.
3. Japan Productivity Movement- Launched in 1950's for the spread of KAIZEN.
4. Vietnam – Launched in 2000's as a National program to improve labor productivity, a critical factor for the middle income country to enhance its competitiveness and development.

Impact of Productivity

Positive and Productive Culture

Highly Skilled Workforce

Reduced Time, Higher Output

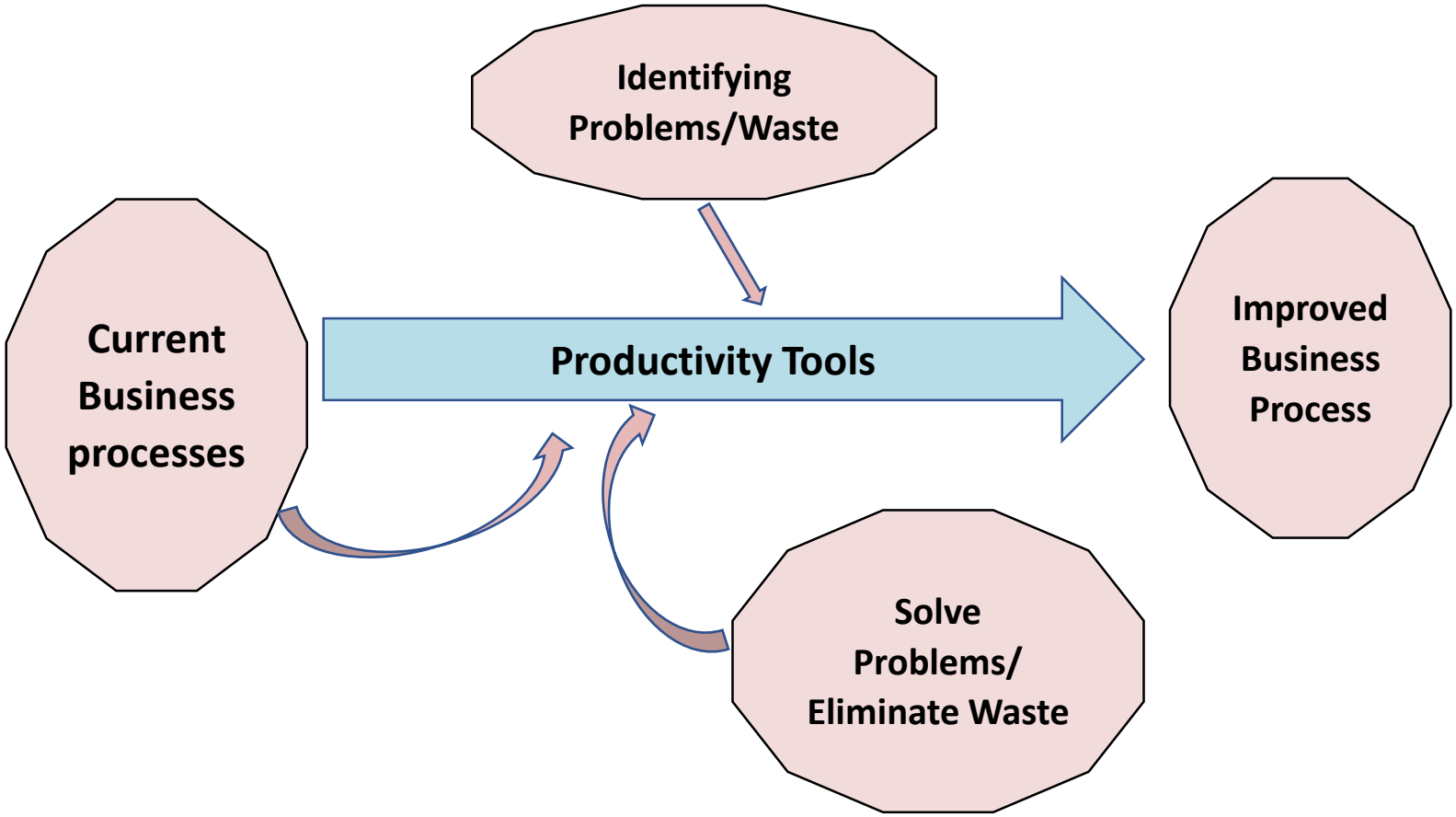
Little Attention, Better Understanding

Productivity Concept

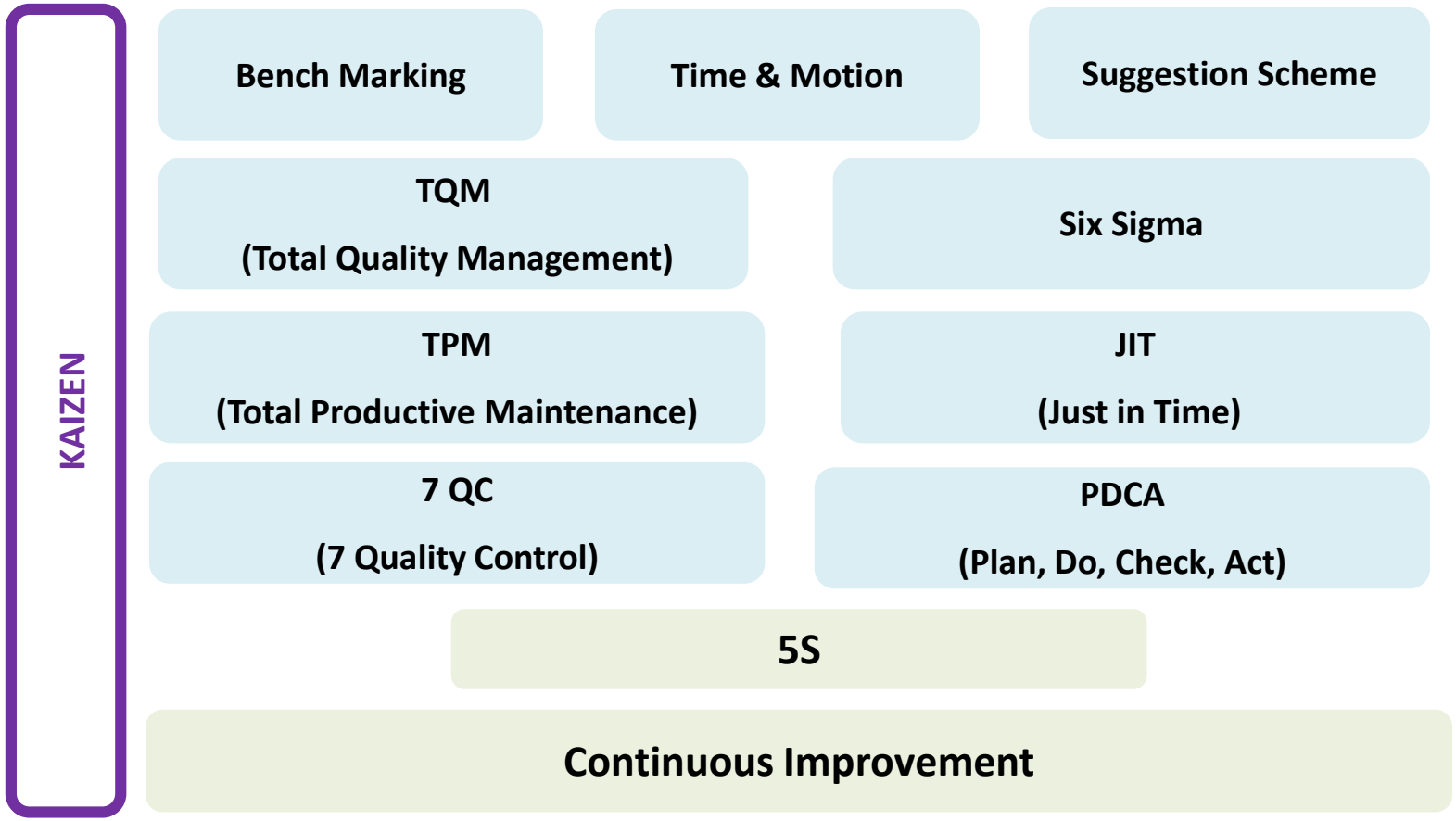
&

7 QC Tools

Productivity Concept



Productivity Tools & Techniques

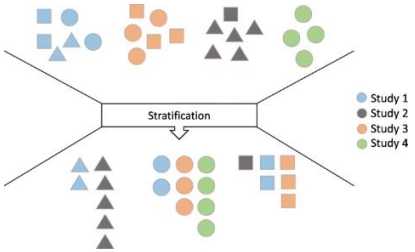


Productivity Tools & Techniques – 5S

Productivity Tools & Techniques – 7QC

1. Stratification

"It is an act of sorting data, objects and people into groups or layers"



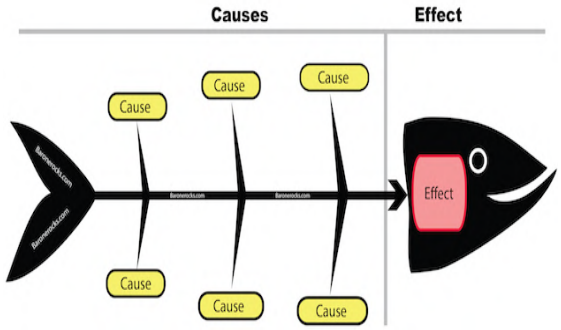
2. Check Sheets

"It is an organized, structured, prepared form for collecting and analyzing data"

Operator		Location		Model	
S.No	**Defect**	**Frequency**			**Total**
1	Crack	𝍸	𝍸	|||	23
2	Blow Hole	𝍸	𝍸	|	16

3. Cause and Effect

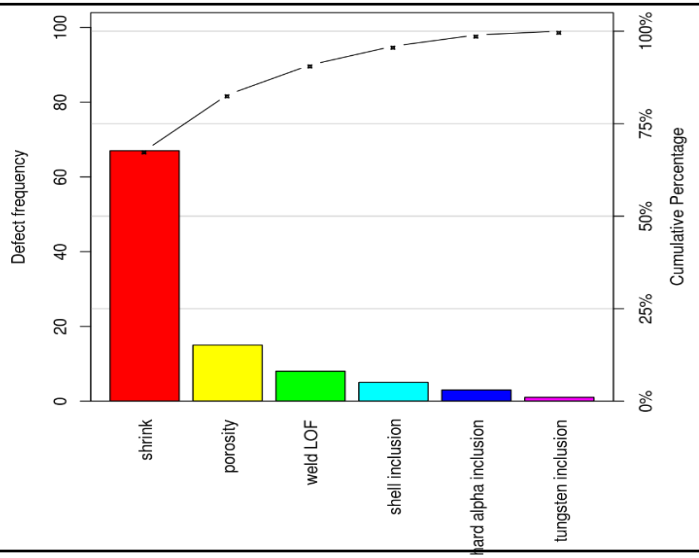
"A relationship between events or things, where one is the result of the other or others"



Productivity Tools & Techniques – 7QC

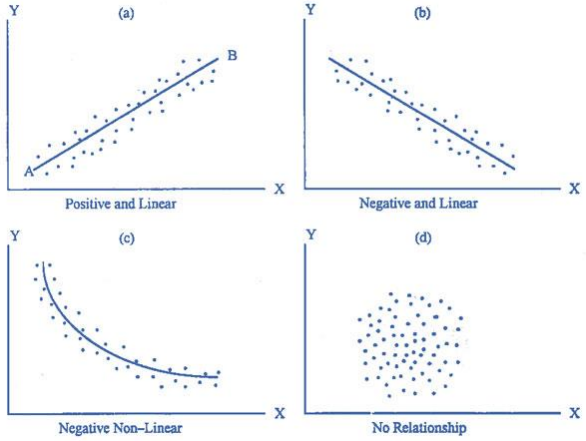
4. Pareto Chart

"It is a graphical representation of the frequency of defects as well as their cumulative impact"



5. Scatter Diagram

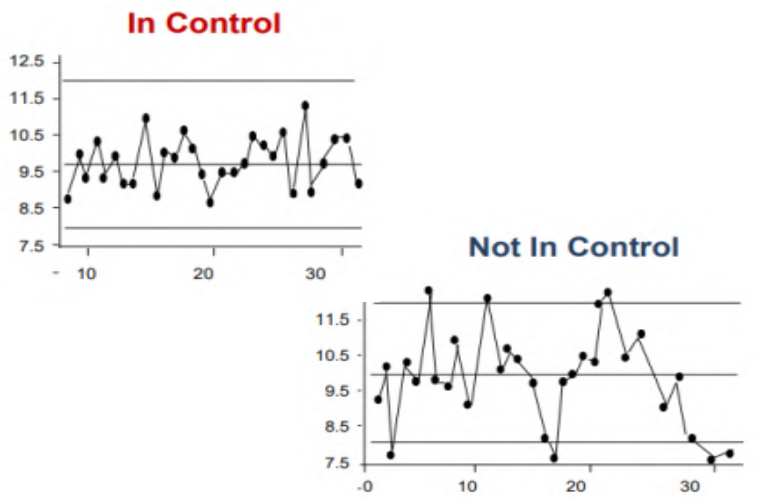
"It shows graphs pairs of numerical data, with one variable on each axis, to look for a relationship between them."



Productivity Tools & Techniques – 7QC

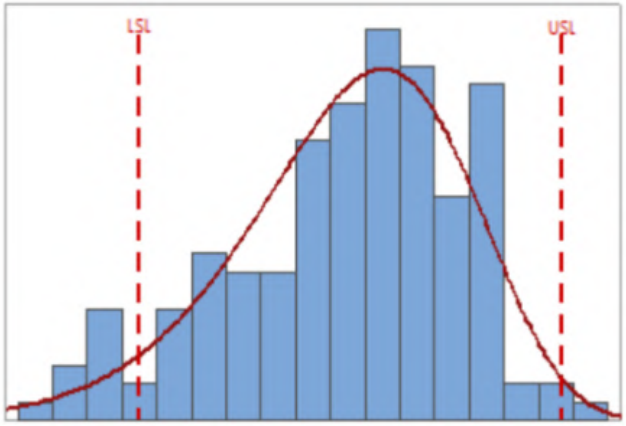
6. Control Charts

"It is a graphical study of how a process changes over time"

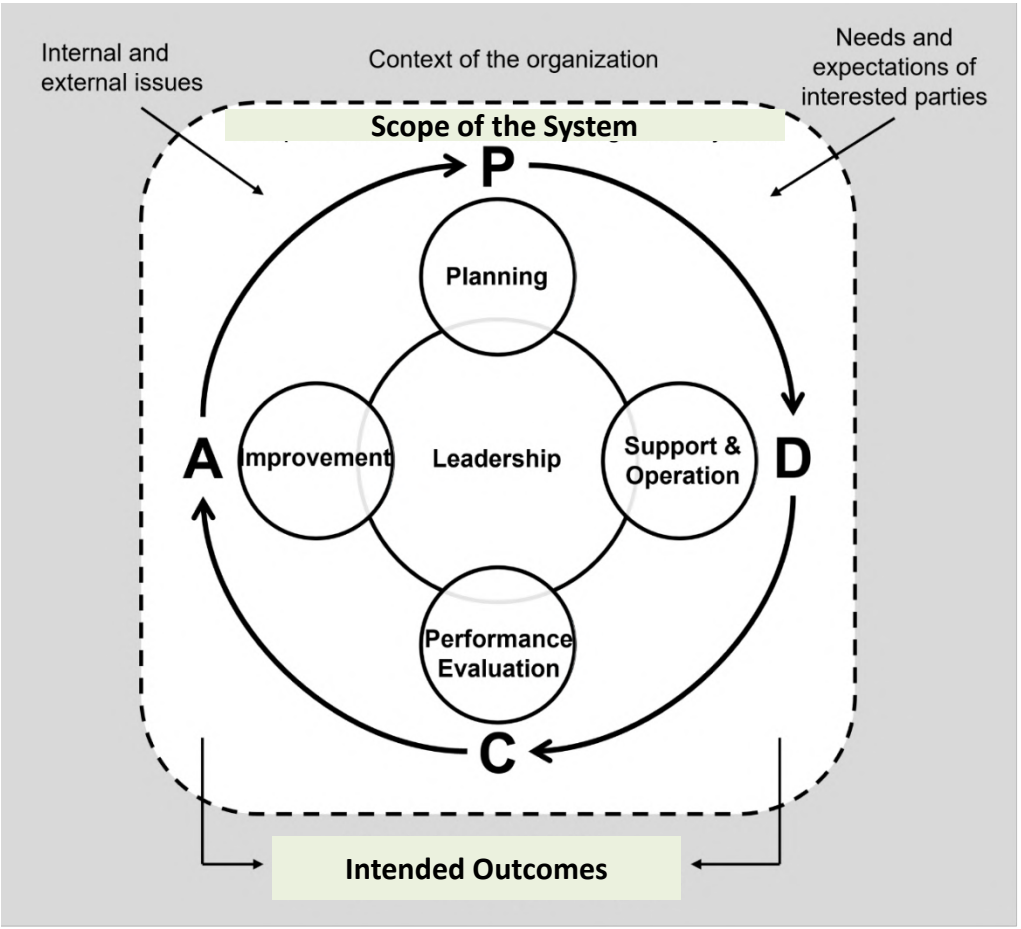


7. Histogram

"It is a graphical representation that helps in organizing a group of data points into user-specified ranges."

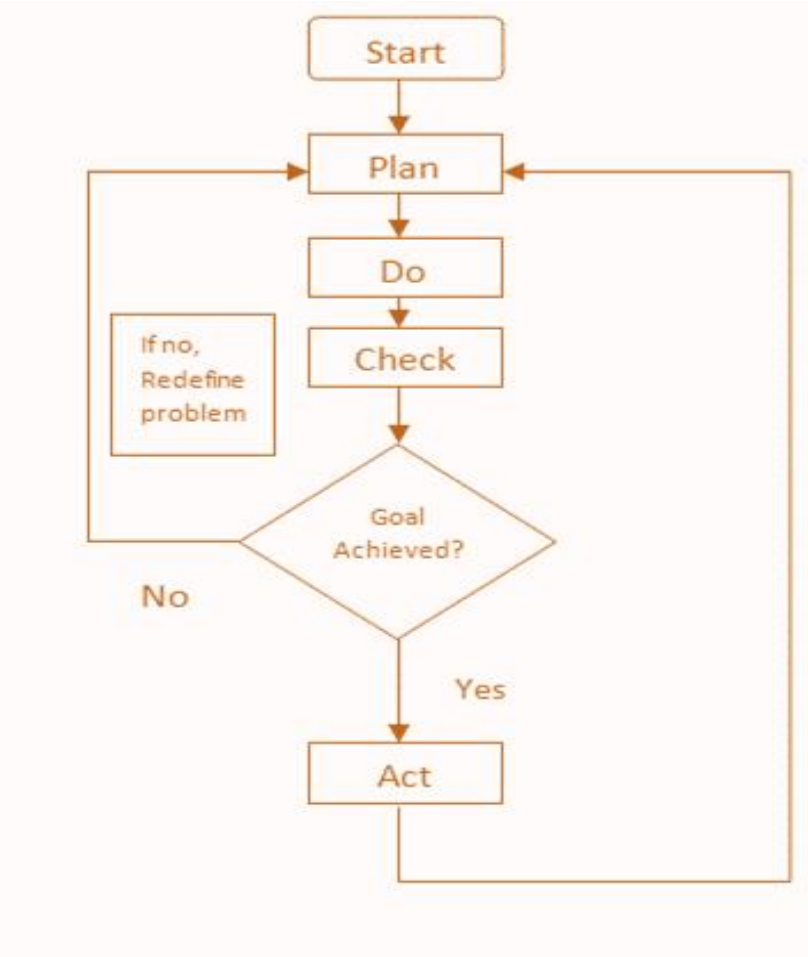


Productivity Tools & Techniques – PDCA



7 Step PDCA Approach	
Plan	1. Select a Theme 2. Collect and Analyze Data 3. Identify the Roo Cause
Do	4. Plan and Implement a Solution
Check	5. Confirm the Results
Act	6. Standardize the Solution 7. Reflect on the Process

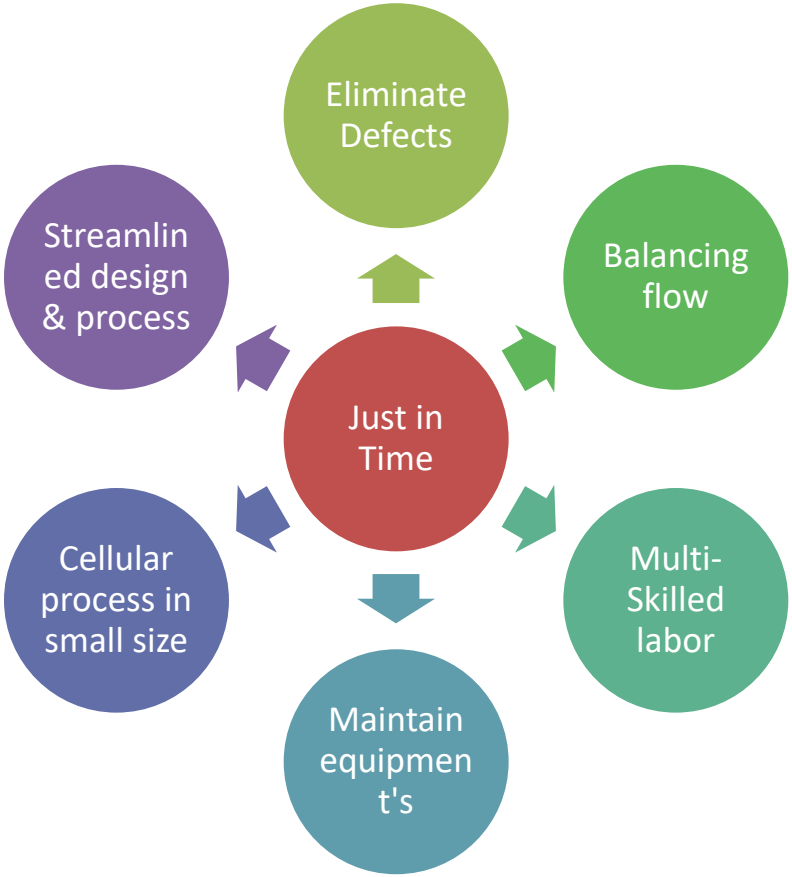
Productivity Tools & Techniques – PDCA



When goals are not achieved as per requirement, planning phase comes into action for re-analyzing objectives as it is an iterative process.

Productivity Tools & Techniques – JIT

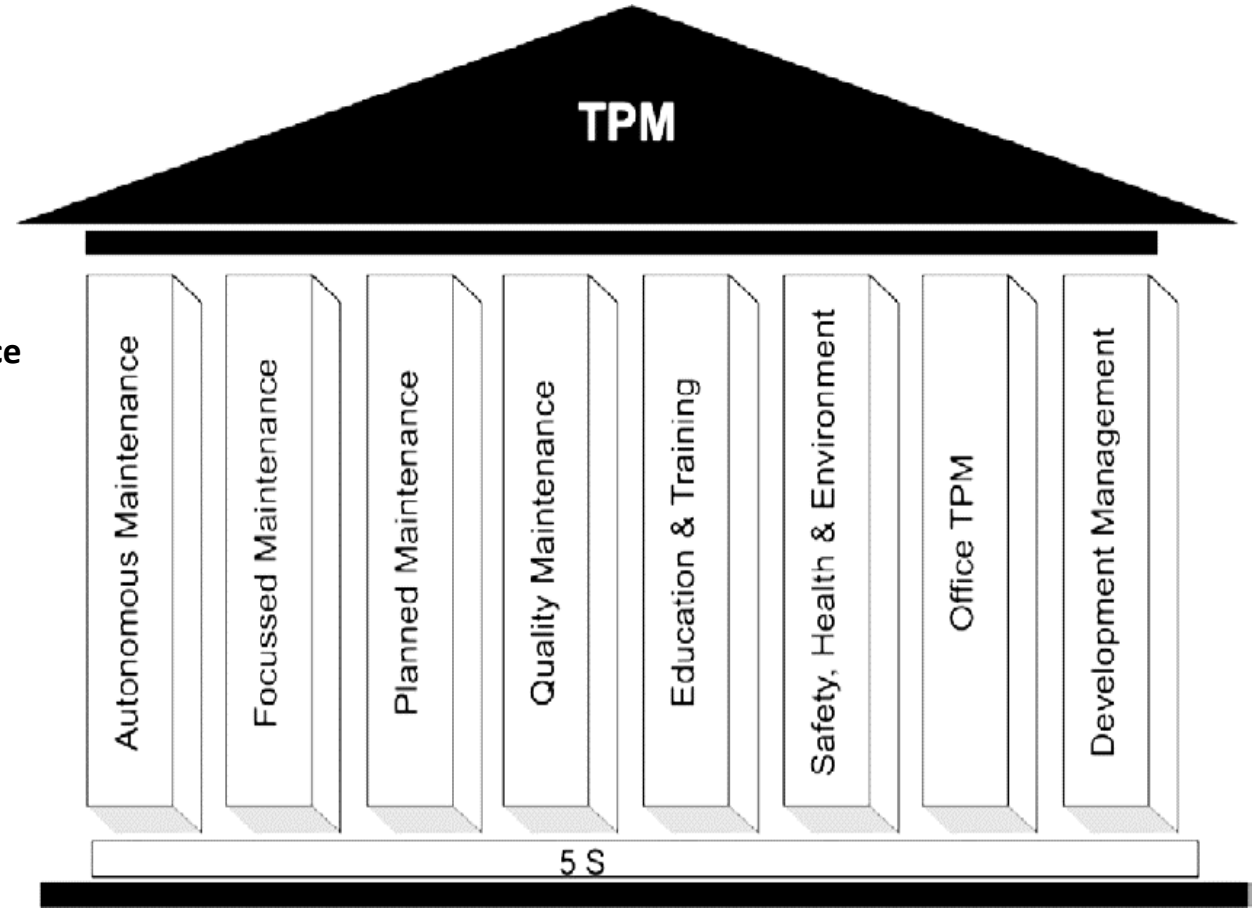
“Just In Time (JIT) is an approach of producing goods and services exactly when they are needed”



Productivity Tools & Techniques – TPM

Total Productive Maintenance

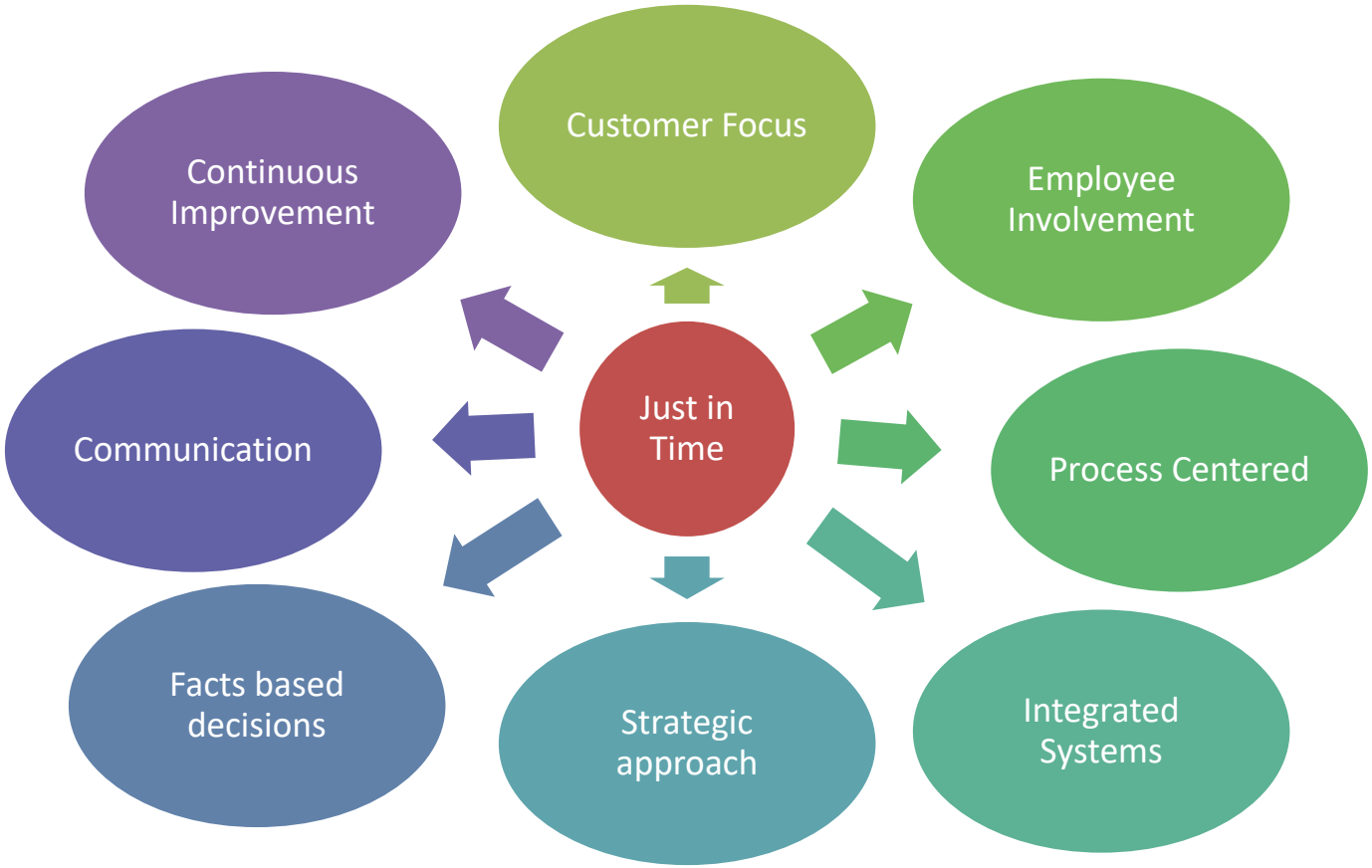
"It is the process of using machines, equipment, employees and supporting processes to maintain and improve the integrity of production and the quality of systems.?



Ref: Noria Corporation

Productivity Tools & Techniques – TQM

“ TQM is a management approach to long-term success through customer satisfaction”



Productivity Tools & Techniques – Six Sigma

“Six Sigma is a statistical- and data-driven process that works by reviewing limit mistakes or defects”

Six sigma is derived from standard deviation and the concept of six sigma seeks to reduce deviation to the barest minimum.

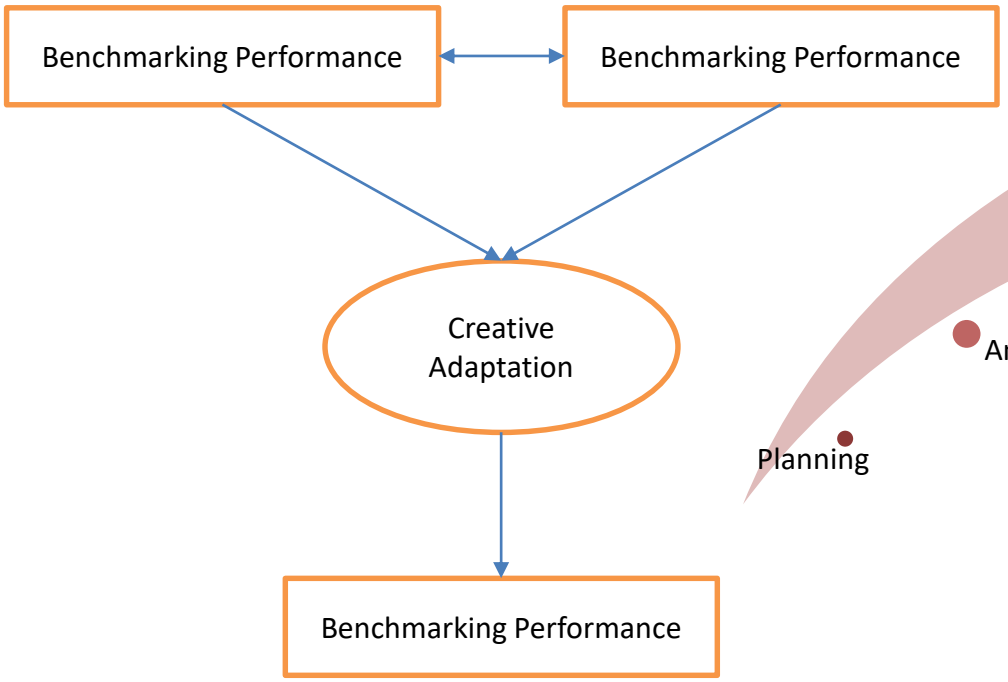
Six Sigma Steps

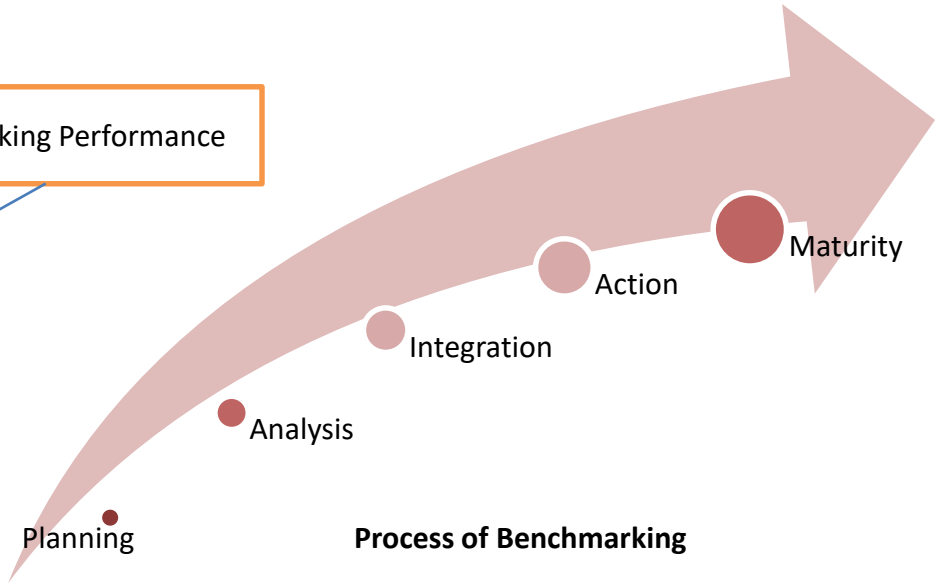
Step 1: Motivate stakeholders by highlighting quality losses.
Step 2: Implement project management and obtain the necessary resources.
Step 3: Educate team members on the Six Sigma management method.
Step 4: Create a quality control chart and identify priorities.
Step 5: Assign ownership for all team members involved.
Step 6: Ensure measurement of the right metrices and indicators.
Step 7: Perform a root cause analysis to understand the defect.
Step 8: Govern the program to ensure proper implementation and continuous

Productivity Tools & Techniques
Benchmarking

"It is a process of measuring and comparing an organization's business processes against business process leaders anywhere in the world, to gain information which will help the organization to improve its performance."

Concept of Benchmarking





Process of Benchmarking

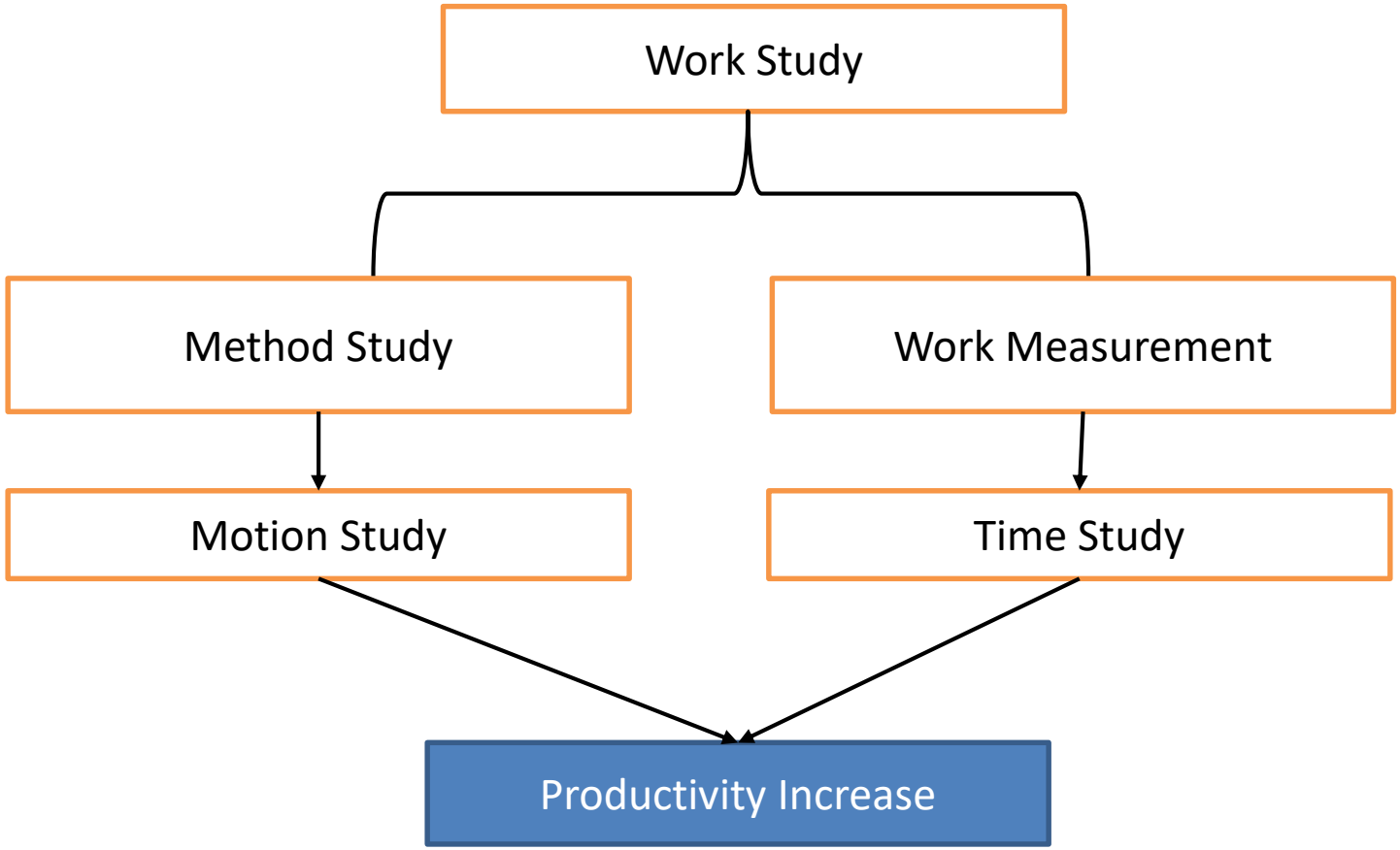
Productivity Tools & Techniques
Suggestion Scheme

"It is a formal channel which encourages every employee to suggest ideas which can be helpful in solving or avoiding problems or improving work process or the work environment"

- Employee Driven Innovation
- Suggestion System
- Suggestion Scheme
- Management System
- Creativity
- Employee Involvement
- Employee Participation

Productivity Tools & Techniques
Time and Motion

"It involves analysis of the time spent in going through the different motions of a job or series of jobs."



7 Quality Control Tools

Definition

“The 7-QC tool or 7 Quality Control tools are set of ‘Statistical and Graphical’ techniques to identify the issues related to quality.”

Dr. Kaoru Ishikawa is the first guru to propose 7QC tools in 1968, by publishing a book entitled “Gemba no QC Shuho” regarding managing quality through techniques and practices.

Dr. Kaoru Ishikawa

Problem Identification

Solutions:
You see it, people talk about it; it is visible.

"Give me six hours to chop down a tree, and I will spend the first four sharpening the axe"

Abraham Lincoln

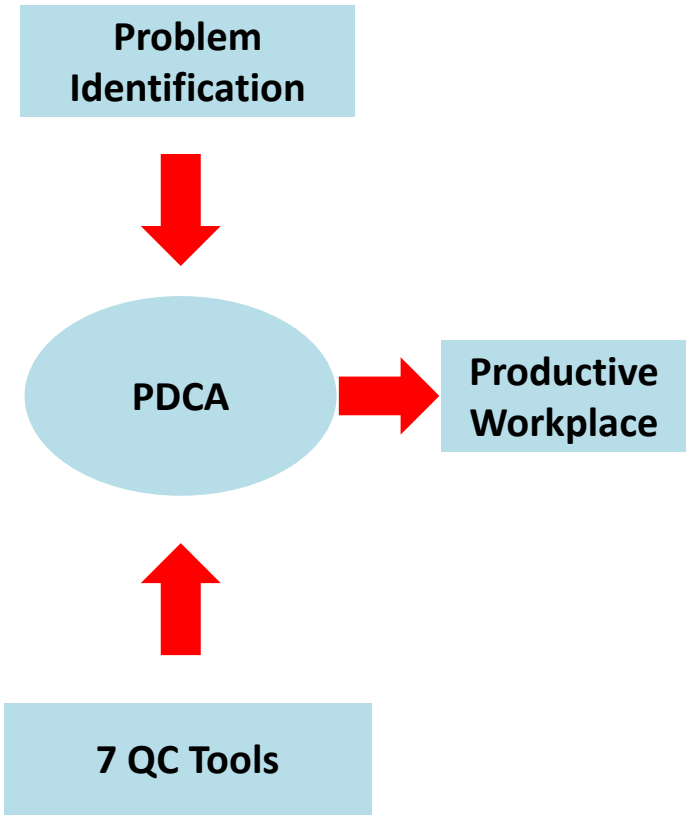
Problem Identification Steps:

- ***Data Collection***
- ***Data Interpretation***
- ***Approach/Methodology***
- ***Tools***
- ***Analysis/***

Root Cause:
It is often hidden you need to find it.

Problem Solving Approach

		Steps for Problem Solving
PDCA	Plan	Clarify Problems
		Breakdown the problem
		Set a Target
		Analyze the Root Cause
		Develop Countermeasures
	Do	Implement Countermeasures
	Check	Evaluate Results & Processes
	Act	Standardize Success



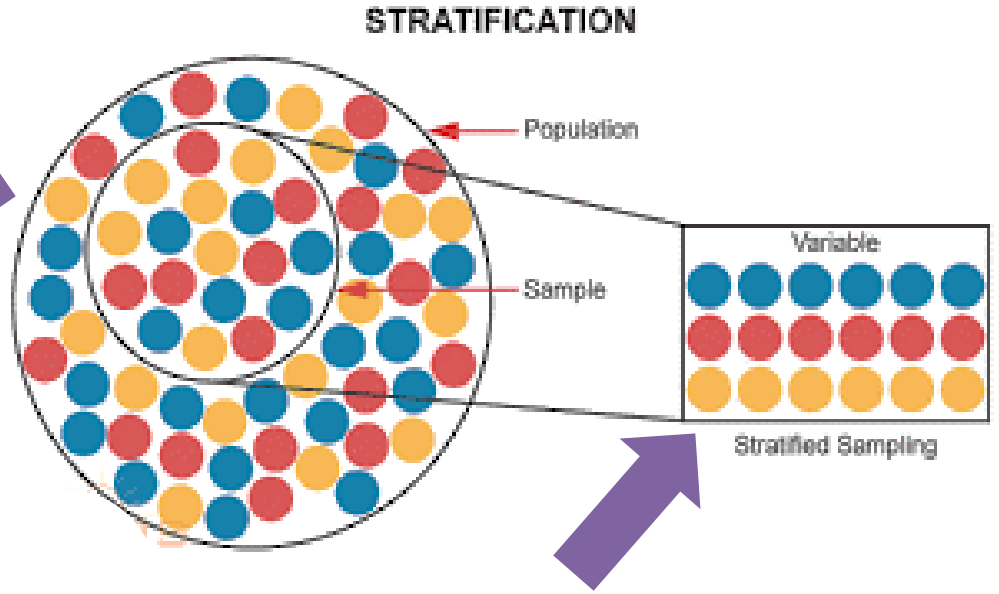
Functions of 7QC Tools

Prioritize problems	⟷	1. Stratification
Show happenings of an event	⟷	2. Check Sheets
Identify causes of problems. Organizes the relation of casual factor.	⟷	3. Cause and Effect Diagram
Prioritize problem areas	⟷	4. Pareto Diagram
Determines correlation. Locate causes	⟷	5. Scatter Diagram
Show that if process is under control	⟷	6. Control Charts / Run Charts
Consolidate data to show an overall picture of process	⟷	7. Histogram

Stratification

It is defined as an act of sorting data, people, and objects into distinct groups or layers.

Data Collected from Sources is lumped



Patterns becomes visible

Stratification Steps

Stratification Formation Steps	
1	Collect Data
2	Create an Excel Sheet
3	Enter X and Y axis Labels
4	Plot Data and Analyze

When to Use Stratification

a. Data is obtained from different sources or conditions, such as data collected from different shifts, machines, people, days, suppliers and population groups.

b. Used extensively to control and improve the process.

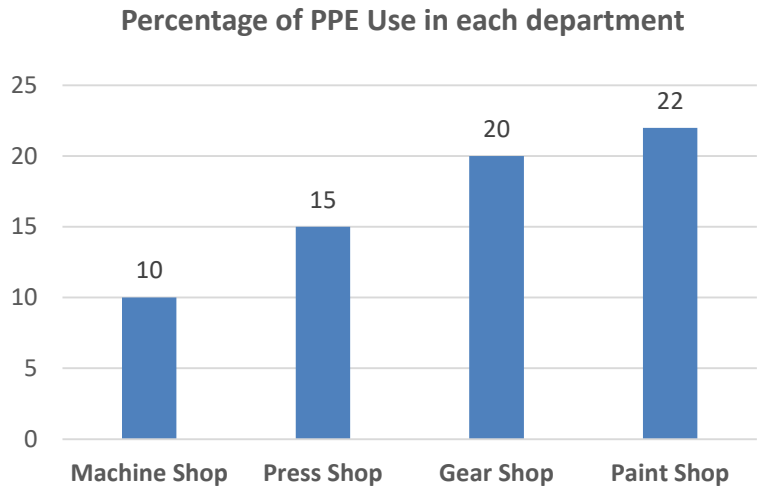
How it is carried out?

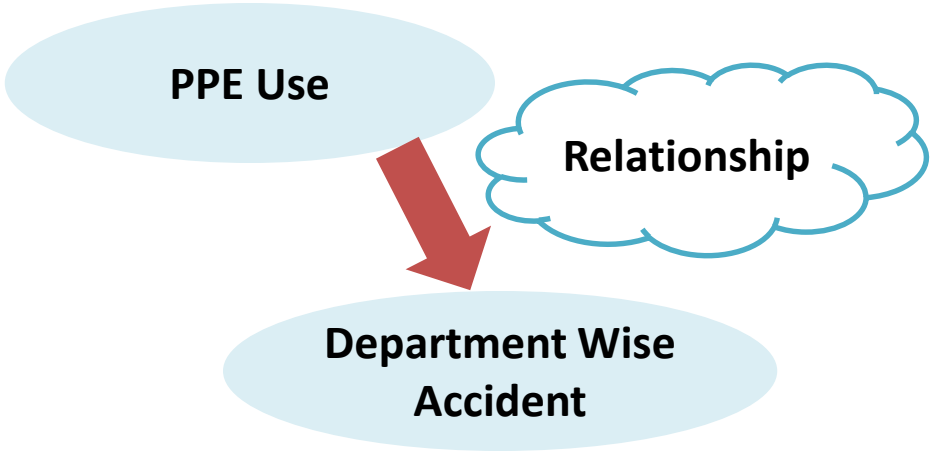
This involves splitting data into distinct layers and understand the different patterns to analyze and solve problems.

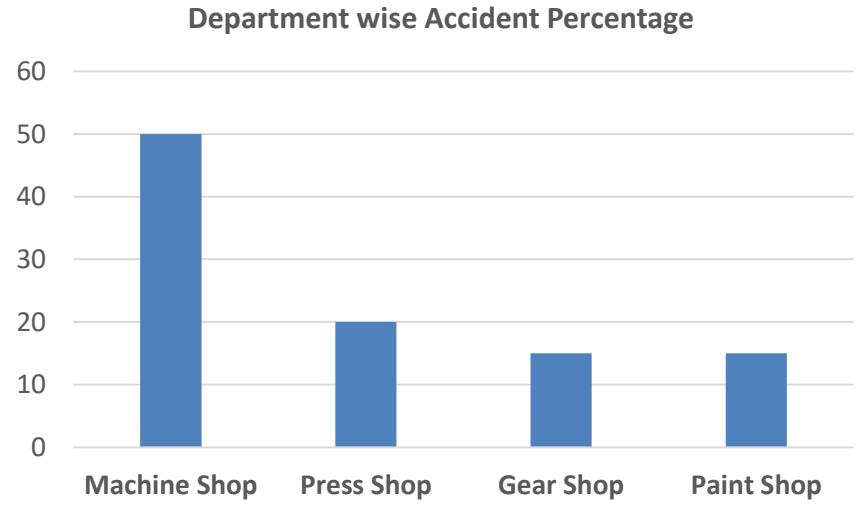
Stratification is used for analyzing "Quality Cost".

a. Internal Failure cost
b. External Failure cost
c. Prevention cost
d. Appraisal cost

Stratification Example







Check Sheets

"Check sheets are simple forms which are used to collect (quantitative & qualitative) data in real time where it is being generated"

Formation Steps

1. **Define Event/Problem Identification**
2. **Data Collection**
3. **Design Check Sheet**
4. **Data Analysis**
5. **Who, What, Where, How and Why**

Check Sheet Examples

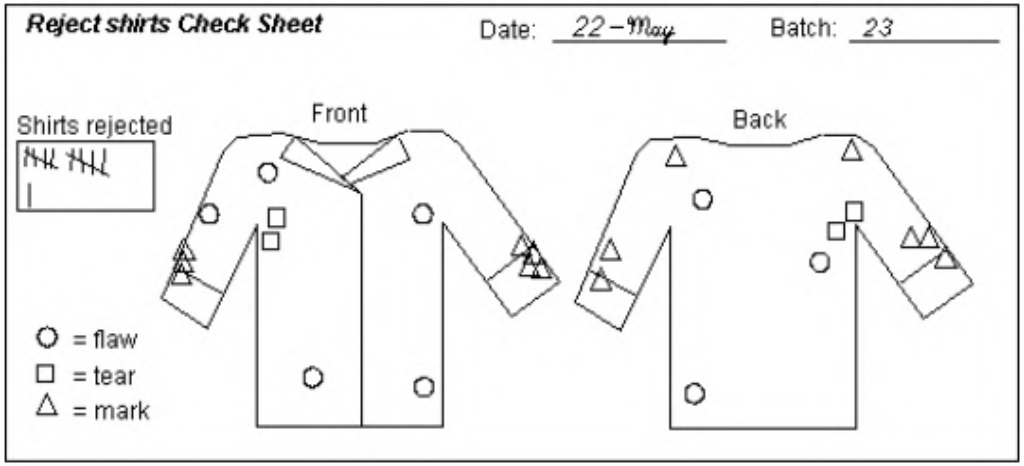
Lot Number: 2M5 Date: July 1
Lot Count: 5030 Checked By: MRB

TYPE	CHECK	SUBTOTAL
Voids	///	3
Tears in Foam		
Width Small		
Width Over		
Foam Diameter Small	//	2
Foam Diameter Over		
Loam Location		
Foreign Material	//// //// //	12
Insert ID small		
Insert Damaged	/	1
Misassembled		
Other		
	Grand Total	18

Remarks: Foreign matter is green and is evenly dispersed when it occurs.

Classification Check/Tally Sheets

Location sheet tracks exactly where the defect has occurred and at what frequency.



Location Check Sheets

Location sheet tracks exactly where the defect has occurred and at what frequency.

Check Sheet Examples

Name of the operator -

Date -

Location -

Section -

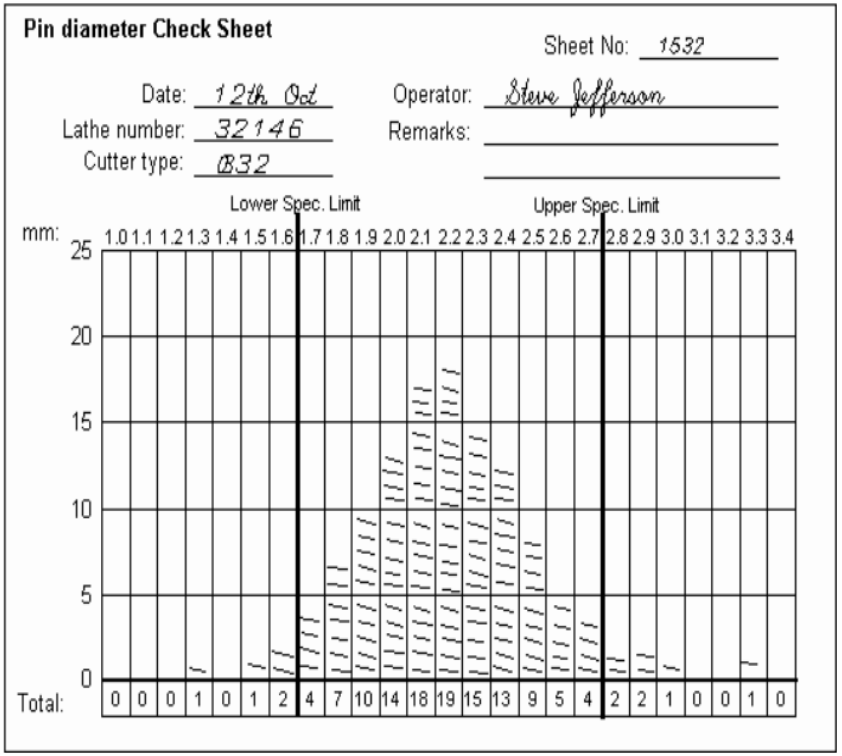
Defect Types	No of occurrences					Total
	Mon	Tue	Wed	Thu	Fri	
Bottles broken	II				III	5
Cap loose		II		I		3
Missing label	III		II		I	6
Dirt	I		II	II		5
Wrong order		III	I	II		6
Damage while packaging	II		II		II	6
Total	8	5	7	5	6	31

Frequency Check Sheets

The defect type sheet is a simple type of check sheet used to mark the occurrence of a specific defect.

Measurement Check Sheets

This check sheets provide visual representation of the probabilistic distribution of certain factors in the execution of the process. An important point when working with this type of sheet is to set the appropriate upper and lower limits according to the specification.



Cause & Effect Diagram Steps

The fishbone diagram identifies many possible causes for an effect or problem. It can be used to structure a brainstorming session

Formation Steps

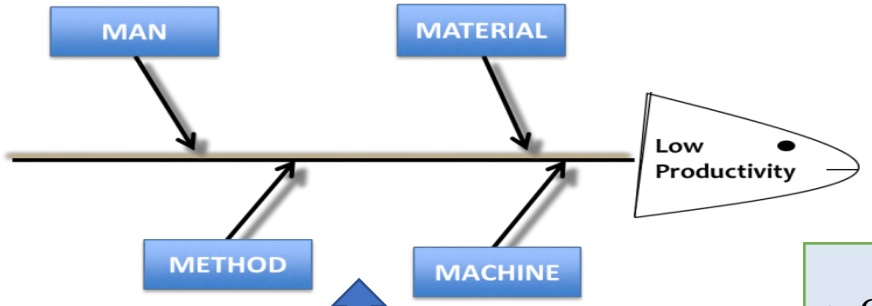
1. Write the effect on the right-most part and connect it into the spine

2. Identify the major causes or groups of causes and write them into the large bones.

3. Identify the causes under each major cause or group of causes by asking the question “why” five times at the most. Write each cause into the middle & small bones.

4. Determine controllable and uncontrollable root causes. (Encircle the root causes).

Cause & Effect Diagram



4M's

Generic Categories of Fishbone Diagram

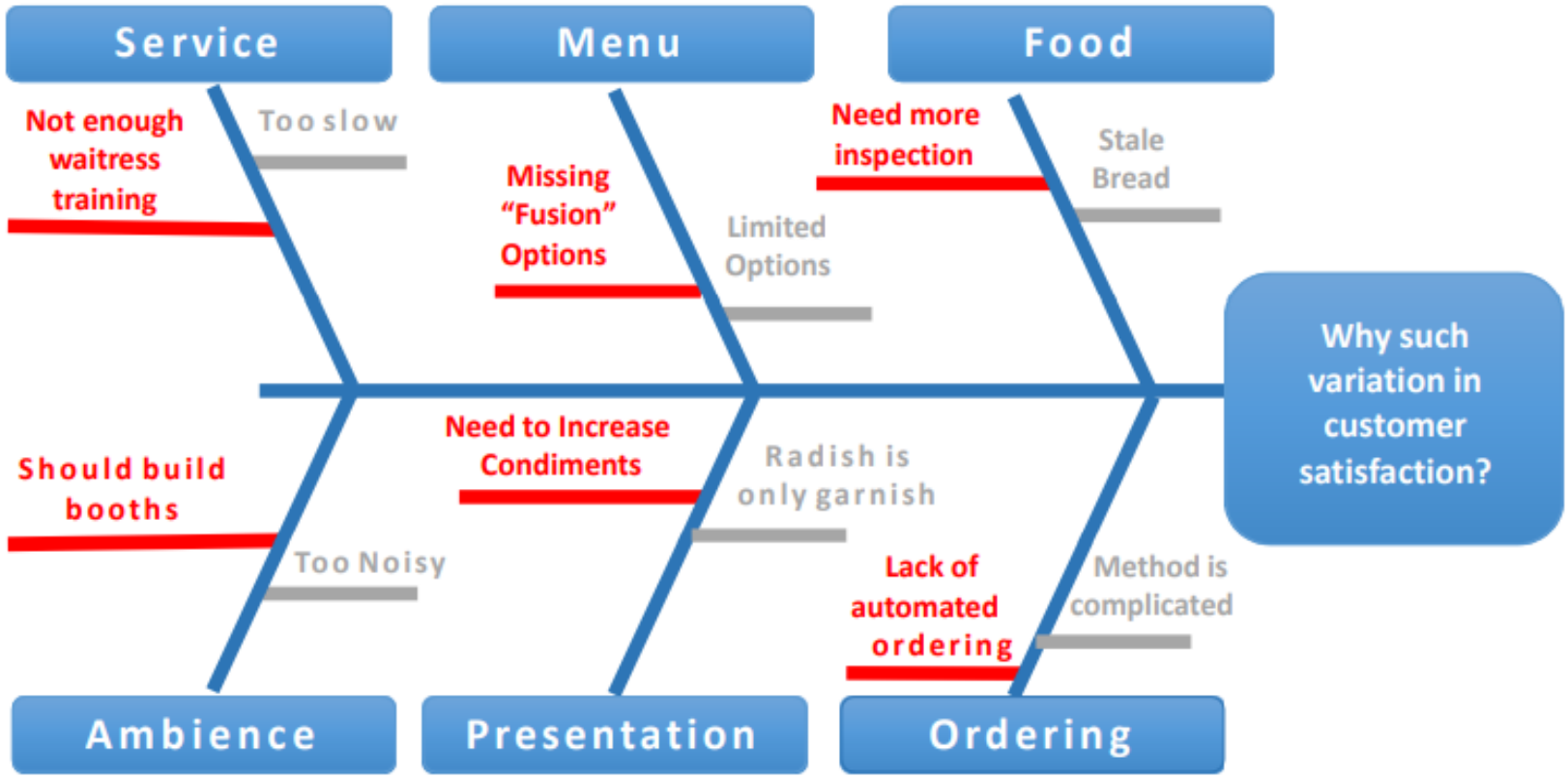
4M + 1E

- Man Power
- Method
- Material
- Machine
- Environment

- Common understanding of the problem
- Exposing gaps in existing knowledge
- Ranking the most probable causes, and studying each cause.

Cause & Effect Diagram Example

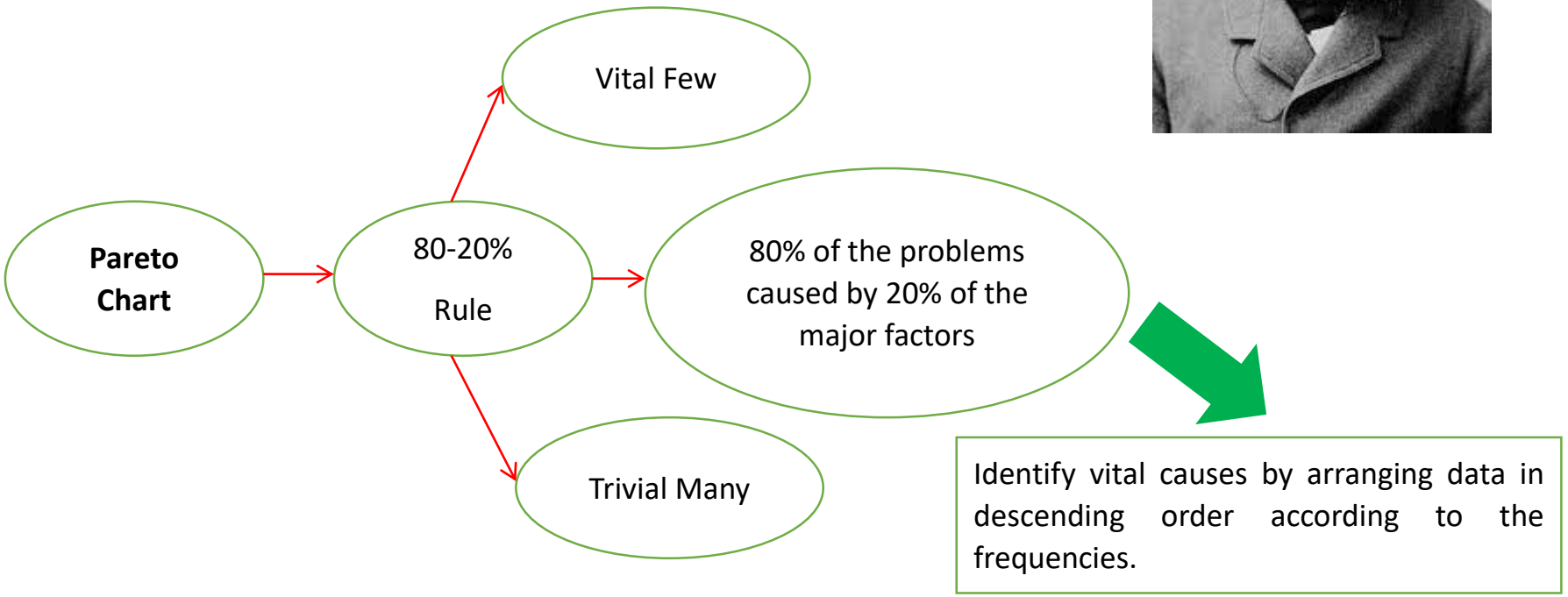
Restaurant Example



Pareto Diagram

A Pareto chart shows *"the relative importance of variables, prioritized in descending order from left to right side of the chart".*

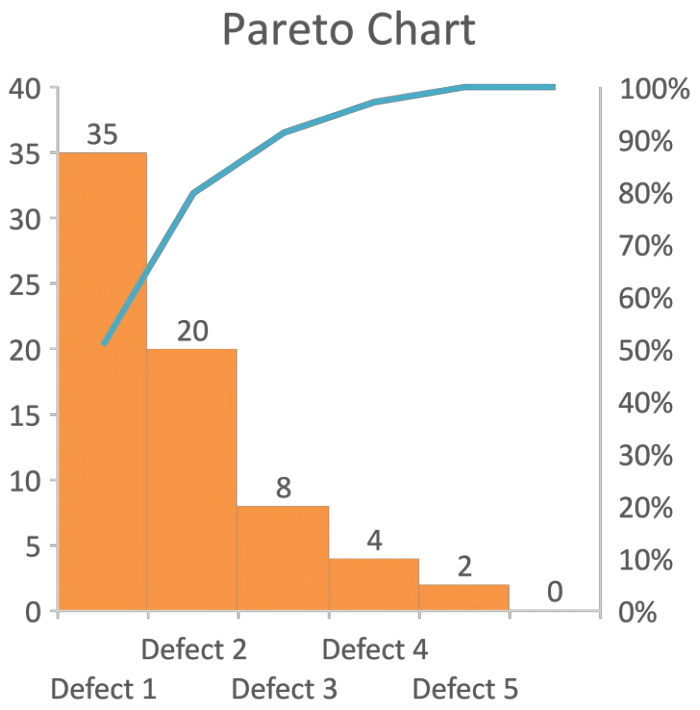
The aim of Pareto chart is to figure out the different kind of "nonconformity" from data figures, maintenance data, repair data, parts scrap rates, or other source



Pareto Chart Steps

Pareto Chart Formation Steps	
No	**Steps**
1	Data Collection
2	Data Sorting
3	Data Analysis
4	Developing Pareto Chart

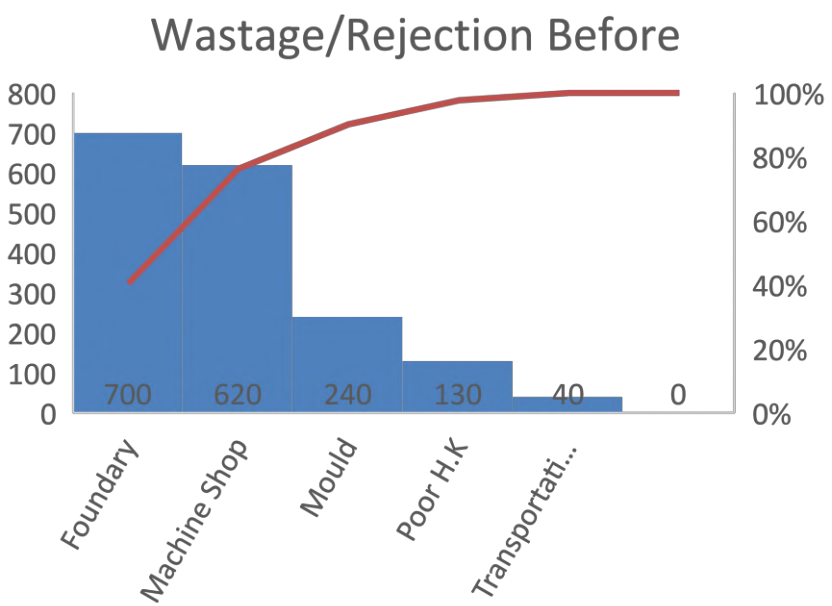
Pareto Chart in Excel Steps	
1	Create the worksheet
2	Stat → Quality Tools → Pareto Chart
3	Enter X and Y axis Labels
4	Press ok & Analyze the chart

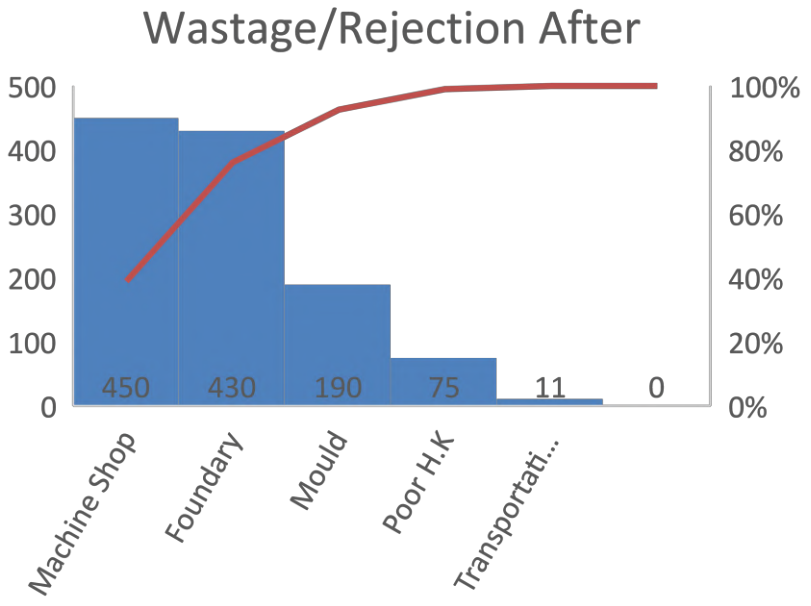


Pareto Chart is the combination of bar and line graph, where bar represents individual value and line represents cumulative value.

Pareto Chart -Example

Analysis of Massey Tractor (Before and After Productivity Analysis)





Scatter Diagram

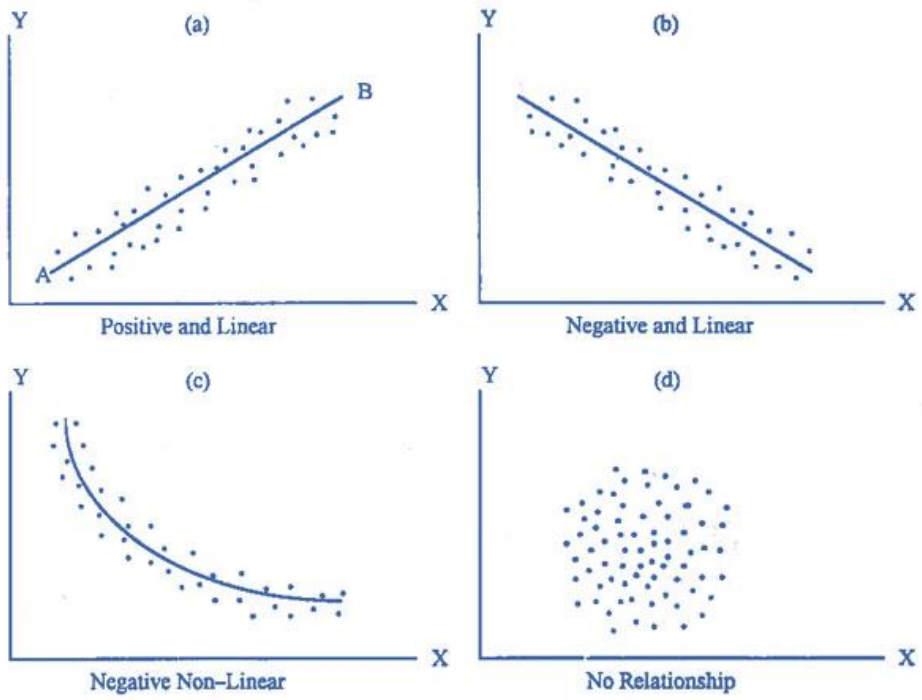
The scatter diagram is also called a scatter plot chart, XY chart, and correlation chart. A scatter diagram is a two-dimensional graphical representation of a set of data.

Use of Scatter Diagram

Scatter diagrams are used when you want to demonstrate the relationship between two variables or when you have to identify data patterns.

Types of Scatter Diagram

1. Positive Correlation
2. Negative Correlation
3. No Correlation



Scatter Diagram

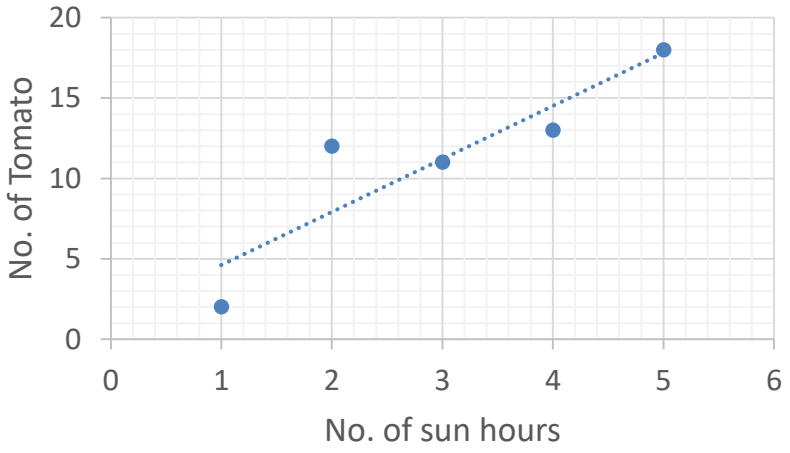
Steps of Formation

1. Define Problem
2. Data Collection
3. Input data in x and y axis.
4. Label x and y-axes.
5. Analyze data and relationship between parameters
6. Conclusion

No. of Hours of Sunlight Exposure (x-axis)	No. of Tomato's on each plant (y-axis)
1	3
2	8
3	11
4	13
5	18

Example

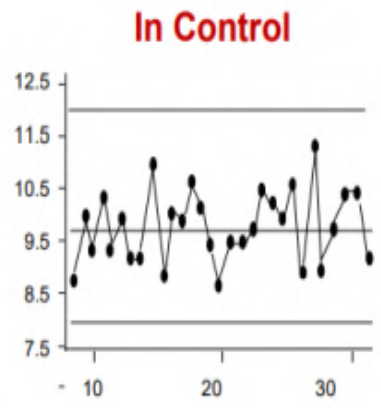
Analyze the relationship between hours of sun faced by each plant and growth of tomato's on each plant.

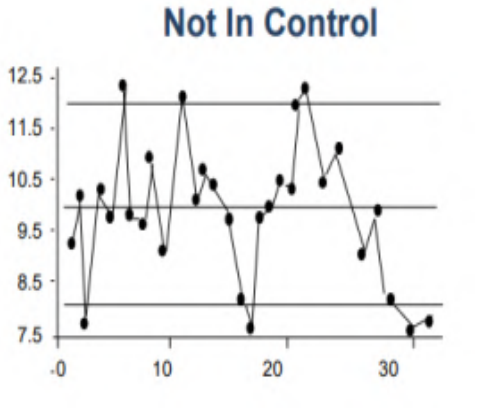


Control Charts and Graphs

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

Charts



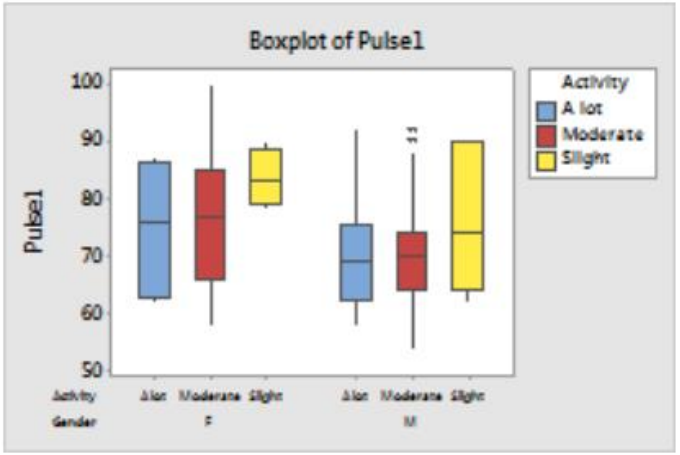


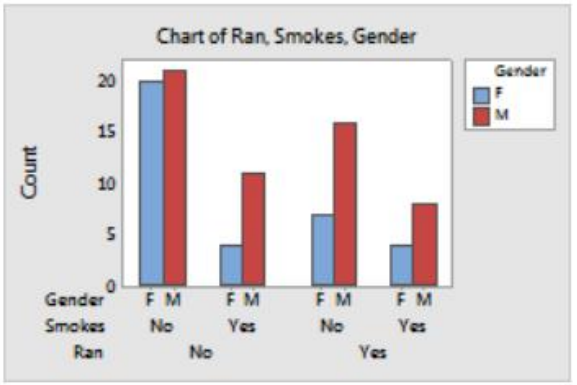
The left shows a process that is "in control," as all data points are between the control limits and variation is also random.

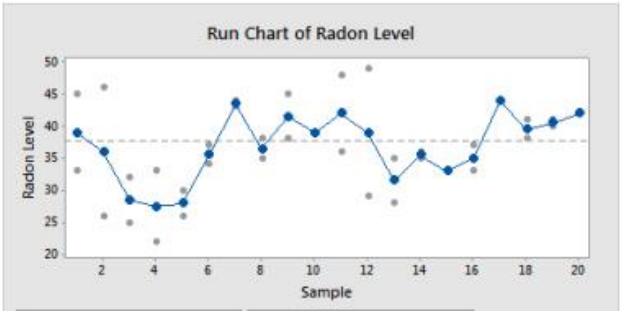
The right shows a process that is "not in control," as several data points are plotted outside of the control limits.

Control Charts and Graphs

Graphs







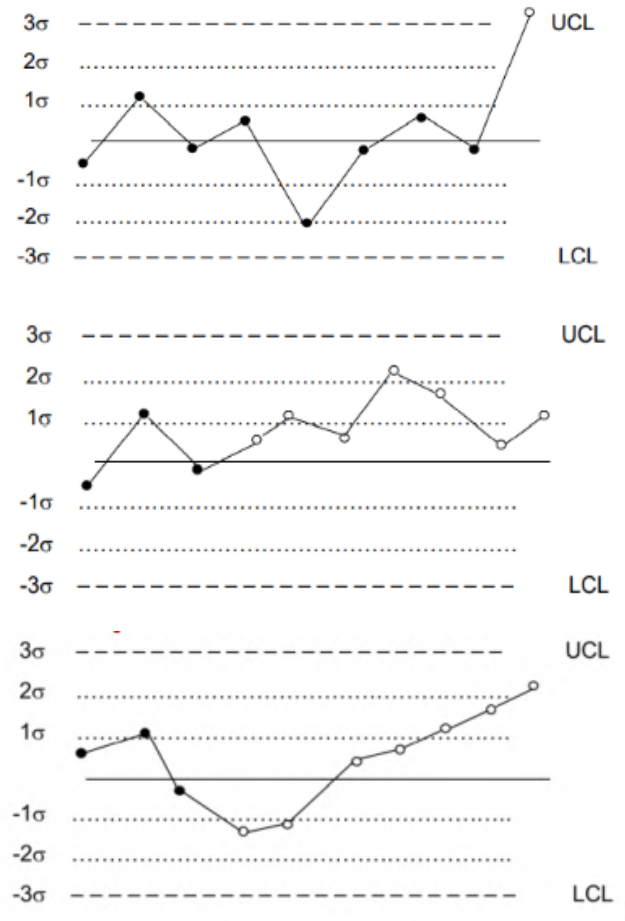
Types of Graphs used for problem identification, data analysis and rectification.

Control Charts and Graphs

No.	Characteristics
1	Data are plotted in time order.
2	A control chart has a central line for the average, an upper line for the upper control limit, and a lower line for the lower control limit.
3	By comparison a conclusion can be drawn about the process variation is consistent or unpredictable.

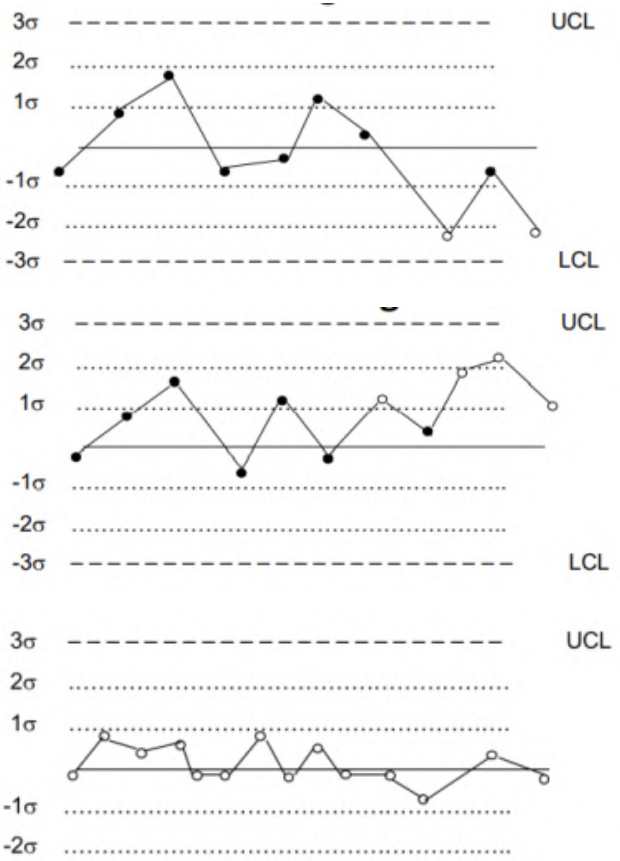
Control Charts and Graphs

Rules Detecting Lack Statistical Control	
1	One point falls outside of the ± 3 Sigma control limits.
2	Seven successive points on the same side of the centerline.
3	Seven successive points Rules for Detecting Lack of Statistical Control that increase or decrease



Control Charts and Graphs

Rules Detecting Lack Statistical Control	
4	Two out of three successive points are both on the same side of the centerline and outside the ± 2 Sigma zone.
5	Four out of five successive points are both on the same side of the centerline and outside the ± 1 Sigma zone
6	Other non-random patterns such as trends, cycles, or an unusual spread of points are within the control limits

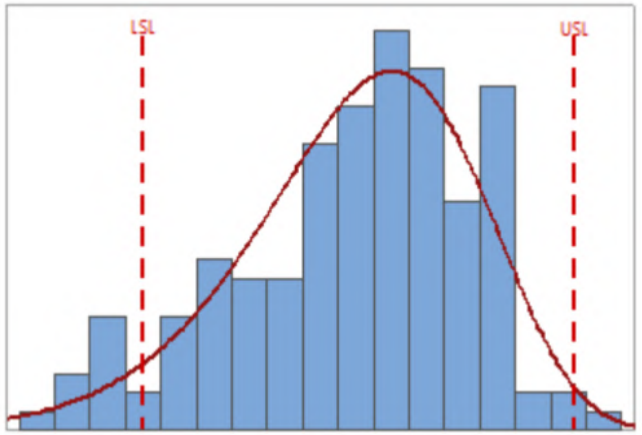


Histogram

"A histogram is used to summarize discrete or continuous data."

Importance of Histogram

- Visual representation.
- Conformity and scope of improvement.
- Display large data.
- Display frequency of data.
- Provides median, mode of data.



Formation Steps

1. Problem Identification

1. Collection of data and Compute the benchmark range

2. Find the number of intervals and interval width

3. Summary of data as per interval size and construct the graph

Histogram Example

Step1: Find the biggest value in the frequency column

Higher Value = 22

Step2: Divide step 1 by 10 (mean) and round to the nearest whole number

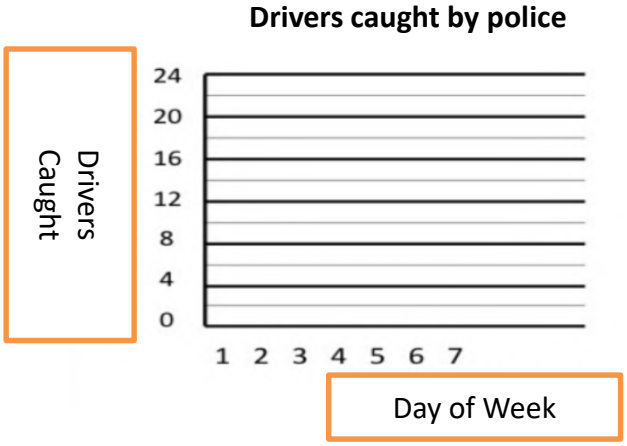
22/10 = 2.2 (rounds of to 2)

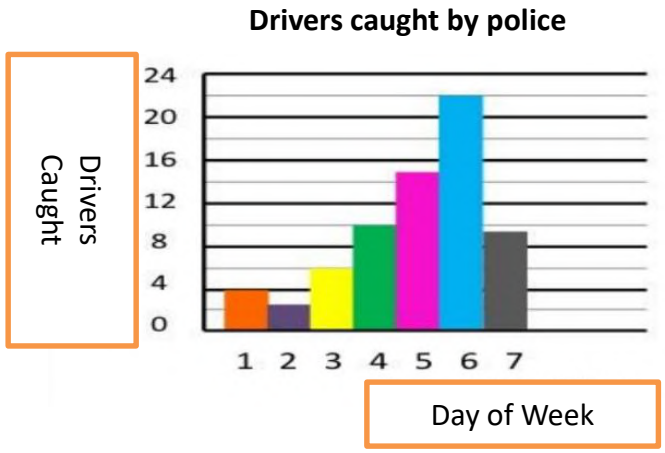
Step3: Identify which item comes on vertical (y) and horizontal (x) axis

Step4: Setup a label and give histogram a title

Step5: Draw graph with no gaps in between bars (Bar Height = Frequency).

DATA	
Day	**No. of drivers caught by police for accidents**
1	4
2	3
3	6
4	10
5	15
6	22
7	9

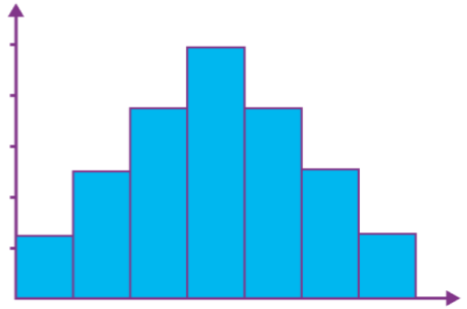




Histogram

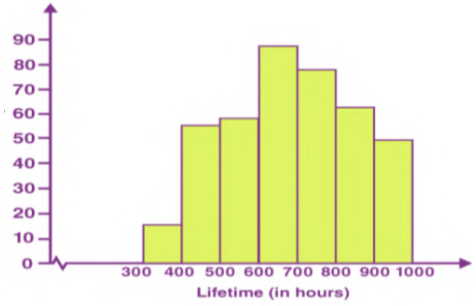
Uniform Histogram

Uniform Histogram indicates consistent data; the frequency of each is similar to that of the others



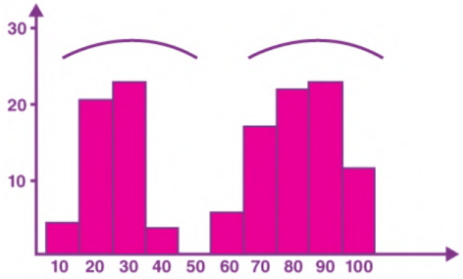
Bimodal Histogram

Bimodal Histogram data set show two peaks or humps.



Symmetric Histogram

Symmetric Histogram indicates in which the 2 "halves" of the histogram appear as mirror-images of one another.



Probability Histogram

Bimodal Histogram the height of each bar shows the true probability of each outcome if there were to be a very large number of trials.

QUOTE

"Productivity is never an accident. It is always the result of a commitment to excellence, intelligent planning, and focused effort"

Paul J Meyer

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