COLLATE

Industrial Managment

Notes

Unit 3-4

SOURCE - NOTESHUB

Syllabus

UNIT – III

Work Study-Method study and time study. Foundations of work study. Main components of method study. Time study standards. Involvement of worker's unions. Work Sampling. Application of work study to office work.

UNIT – IV

Quality Management- What is Quality? Control Charts. Quality is everybody's job. Taguchi Philosophy. Service Quality. What is Total Quality Management (TQM)? Roadmap for TQM. Criticism of TQM. Six Sigma.

Work Study

Work study is an Imp. tool in hands of management for achieving greater productivity in the Organisation.

→ It is an analytical study of the use of workers, materials & equipment in Order to Improve existing methods & work performance by elimination of every type of waste.

Work Study Techiques
- Method Study
- Work Measurment

objective of Work Study

1) To analyse the present method of doing a job systematically in Order to develop a new & better method.

2) To establish standard time by measuring the time required to do the job by a qualified worker.

3) To Inc. the productivity & to achive best quality product at min. cost

4) To Improve operation efficiency.

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Advt. of Work Study

1) Effective use of manpower
2) Effective use of method, machine & equipments
3) Efficient layout of plant & improved workflow.
4) Simplification & standardisation of operations.
5) Inc. productivity & operational efficiency.
6) Reduced material handling cost.
7) Greater job satisfaction to employees.

Steps in Work Study

It includes Eight step process —

1. Identify & select the job.
2. Recording — (Using the most effective recording technique)
3. Examined & analysed (data & facts obtained in previous steps examined)
4. Develop the most economical method.
5. Measure the quantity of work using appropriate methods of measurement. Cal. std. Time.
6. Define best method & required Time.
7. Install new method
8. Maintain the standard practise by a proper control mechanism.

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Method Study → It is the systematic recording & critical examination of existing & proposed ways of doing work.

Work Measurment → It is the application of techniques design to establish time for a qualified worker to carry out a specified job at a defined level of performance.

Involvement of Trade Unions

Resistance to work study by workers & Unions –

Work study is often resisted by workers cz of fear of financial loss & creation of social problems. For overcoming such resistance, the following steps should be taken by management –

1) Management must take initiative for free consultation with the workers, unions before the work study is started.

2) There must be a definite policy for the adjustment of the redundant (unnecessary) worker or their voluntary retirement.

3) Workstudy improve the flow of work & supply of material

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Resistance to Work Study by Managers -

Managers may also show resistance to work study if it involves changes in work method & learning of new practices.

Resistance to work study by managers can be overcome by following steps -

1) Adequate communication of the purpose & benefits of work study to organisation & the staff.

2) Misconceptions about work study must be cleared.

3) The suggestion by the managers should be given due consideration.

4) The managers must be given a role in planning & implementation of work study.

Method Study OR Work Simplification

It can be defined as systematic procedure for analysing the existing method of doing a job including the various human movement involved in it.

→ The main objective of method study is to evolve the most economical method of doing the job.

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Objective of Method Study

1) To Improve manufacturing process & procedure.
2) To Improve factory, office & workplace layout.
3) To Improve plant & equipment design.
4) To Reduce human fatigue & effort in performance of work.
5) To Improve the Use of manpower, machine power & material.
6) To Improve physical Working Condition.

Advantage — ① Improved working method
② Work Simplification ③ Better product quality.
④ Improved workflow & workplace layout
⑤ Improved equipment design.
⑥ Higher Safety to workmen
⑦ Optimum utilization of all resources.

Steps In Method Study → [SREDIM]
↓
Stand for a six Verb
↓
(activities or Steps)

Select (S) → Record (R) → Examine (E) → Develop (D) → Install (I) → Maintain (M)

SREDIM approach to method Study

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1) Selection of
2) Collection of Recording facts → all the Relevant
3) Examination of data → all the facts recorded
4) Development of improved method → The best method
5) Installation → The New method
6) Maintenance. → The New method by Routine checks.

~~Techniques~~ Purpose of Method Study

It may be noted that method study covers three broad areas —

(i) It is a diagnostic tool (Locating of faults)
(ii) It is a Remedial tool (Improvement of situation)
(iii) It is a Constructive tool (Sets standard for control)

Economic Consideration In method Study

(i) Cost of study
(ii) Time loss due to Investigation
(iii) Costs associated with the Implementation of change In present methods.

(The Considerations for above three costs are imp, as the method study is primarily based on the principle of economic use of resources.)

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Process Analysis

- It is a part of method study / work simplification programme in any enterprise.

→ It deals with the subdivision of process of manufacturing into its basic elements & also the subdivision of material movements.

→ A process usually consists of –

(a) Set of tasks (b) flow of material

(c) Storage of material & Information

Advantages of Process analysis

1) It facilates understanding of the overall nature of process under study.

2) It eliminates the Unproductive & Unnecessary elements in the process.

3) It eliminates Improper utilisation of men & machines.

4) It ensures Speedy work by cutting delays.

Steps In Process Analysis

1) Select the Process

2) Breakdown the Process Into Operation.

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Construct a process chart & a flow diagram.

Analyse the process chart & flow diagram

5) Reconstruct the process chart.

6) Test the proposed method.

7) Explain the New method to workers & put it into operations.

Process charts

A process chart is a diagram which gives an overall view of the process.

→ It helps in visualising various possible alternations or improvements.

→ It records graphically the operations connected with a process.

→ No. of symbols used in Process chart.

Process chart Symbol →

(1) Operation → ○ → It indicates the main steps in a process.

(2) Transportation → ⇨ → It indicates the movement of material

(3) Inspection → □ → It indicates any type of inspection or checks measurement.

(4) Delay → D → It occurs when something stop the process.

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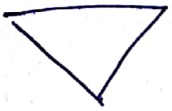
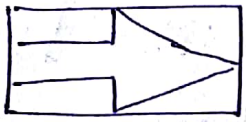
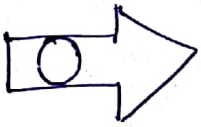
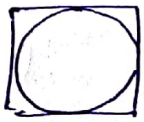
Storage →  → It indicates a stage when a finished goods awaits in action.

(6) Transportation & Inspection →  → It indicates the combined activity of Transportation & Inspection.

(7) Operation & Transportation →  → Combined activity of O & T

(8) Inspection & Operation →  → Combined activity of I & O.

The process chart may be classified as —

1) Outline Process chart
2) Flow Process chart - multiple activity chart.
3) Two hand Process chart

(1) Outline Process chart

→ This chart records overall picture of process & states of only main events.

→ It consider only main operations & symbol & thus it makes use of only two symbols.

→ Symbol used only — operation ○
& Inspection □

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Flow Process Chart

→ It is the detailed version of outline process chart.

→ It Records all the events.

→ It is defined as a graphic representation of all operations, transportation, inspection, delay & storage occuring during the procedure & also includes information such as time required & distance moved.

→ It is of three types —
(i) Man flow process chart
(ii) Material " " "
(iii) Equipment " " "

Objective of Flow Process Chart

(i) To Visualise the Complete sequence of events occuring in a process.

(ii) To Study events in a Systematic manner.

(iii) To Reduce distance travelled by raw material during the process of manufacture.

(iv) To Reduce distance travelled & storage of finished parts.

(v) To minimise movement of men in shop.

(vi) To eliminate non-productive time of operation.

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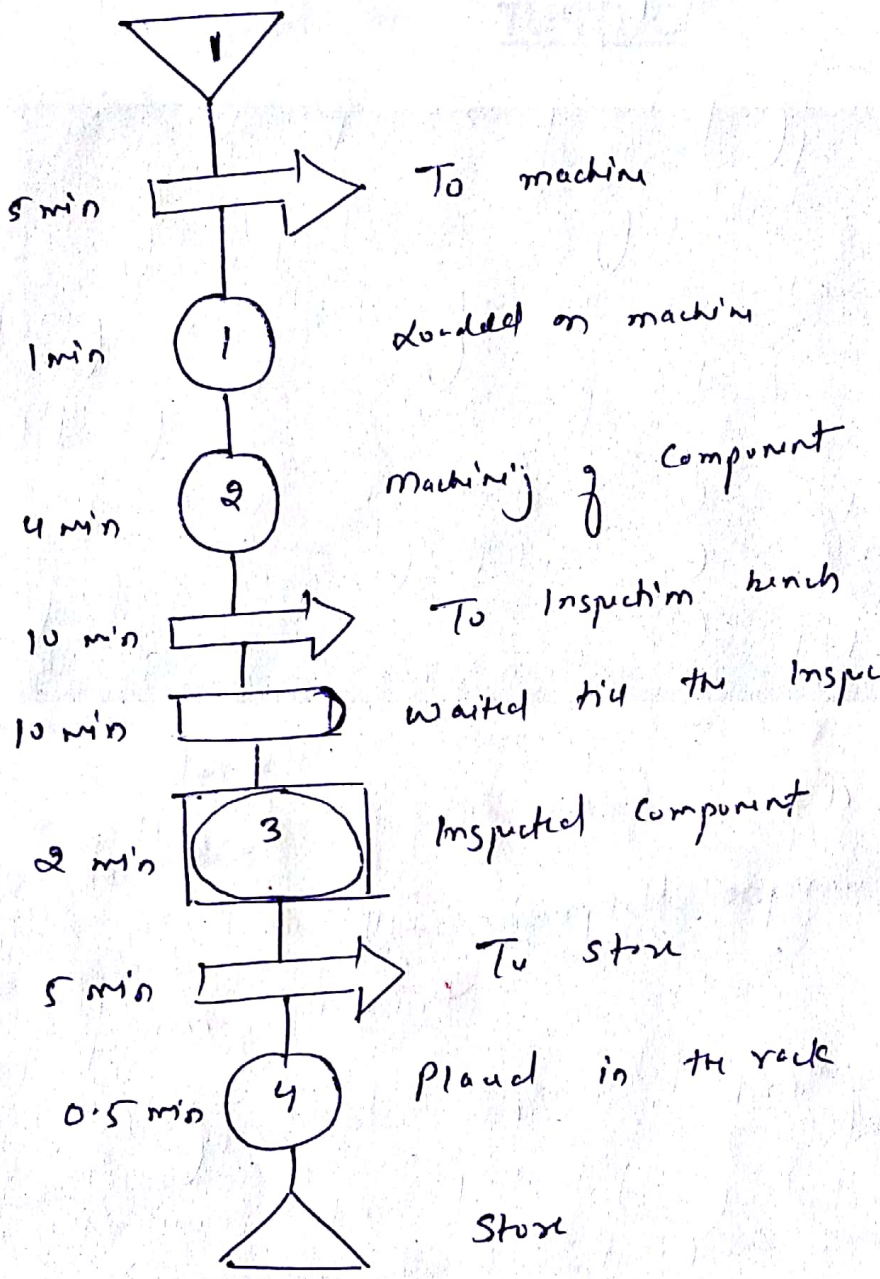
Flow process chart for machining the component-



Summary of flow chart

Symbol	frequency	Time	distance
○	4	7.5 min	–
⇨	3	–	20
▭	1	2 min	–
D	1	10	–
▽	2	–	–

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Multiple Activity chart

→ It is a chart on which activities of men or machines are recorded on a common time scale in order to show their interrelationship.

→ The multiple activity charts are used to study ideal time of man & machine.

→ These charts are used when a process involves a coordination of services.

Objective

→ To detect the ideal time of machine & man.

→ To optimise work distribution b/w workers & machines.

→ To balance the work team & to decide the no. of workers in the group.

→ To develop the improved method of doing a task.

Types of multiple activity analysis chart –

(i) Man - machine chart :- One man handling machine

(ii) Man - multimachine chart :- One man handling a no. of machine.

(iii) Multi-man machine chart :- A no. of persons working on a computer system. Two symbols are used in the chart. One shows working & other shows idle condition.

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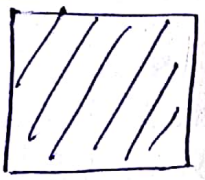
Symbols are shown as –

Symbol	Description
1. 	The shipped space shows that both man & machine are working.
2.	It is used to show that one of the two i.e. man or machine is in idle state.

How to draw multiple activity chart?

→ To draw multiple activity chart, a seprate vertical bar is used for each man or machine.

→ A common time scale is provided for all machines & operators.

→ Activities of each machine or man is marked in the respective coloumn.

Application of multiple activity chart

1) Plant Repair & maintenance.
2) Planning Team work
3) Making the Jobs etc.

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Multiple activity chart

Time	Man			Machine	Time
0.5	Cleaning & Casting			Idle	0.5
0.5	Fitting to Remove sharp edges			Idle	0.5
0.4	Keep casting in box & pick up next.			Idle	0.4
1.0	Cleaning of machine			Idle	1.0
1.2	Locate casting in fixture & start machine			Idle	1.2
1.5	Idle			Cutting Slot	1.5
2.0	Idle			Cutting (min)	2.0

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Two Handed Process chart

This is the most detailed type of flow chart in which the activity of the workers hands are recorded in relation to one another.

→ It gives synchronised of graphical representation of the sequence of manannual activities of workers.

→ Two handed process chart has two charts, one for the left & other for the right hand.

→ The simultaneous activities are recorded opp. to each other on the chart.

Symbol

1. ○ operation — An operation occurs, whenever the hand grasps, assembles tools etc.

2. ⇨ Transport — It occurs when the hand moves from one position to another at the workplace.

3. ▭ Delay — When there is no any activity performed.

4. ▽ HOLD — A hold occurs when the hand holds an object. so that the other hand may be able to do something to that obj.

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Flow Diagram & String Diagram

The flow process chart shows the sequence & nature of movement, but it does not show the path of movements.

→ There are undesirable features like back tracking & unnecessary long movements, so to record these unnecessary features flow & string diagram are used.

FLOW DIAGRAM

→ It is a drawing showing the various activities identified by their numbered symbols & are associated with a particular flow process chart i.e. man or material type.

→ The Relative positions of the m/c tool, work benches, storage, Inspection benches are marked on scale.

→ The path followed by material / man is traced by drawing lines.

→ The raw material from the store moves to station A, where a operation is performed. The semifinished component is sent to station B.

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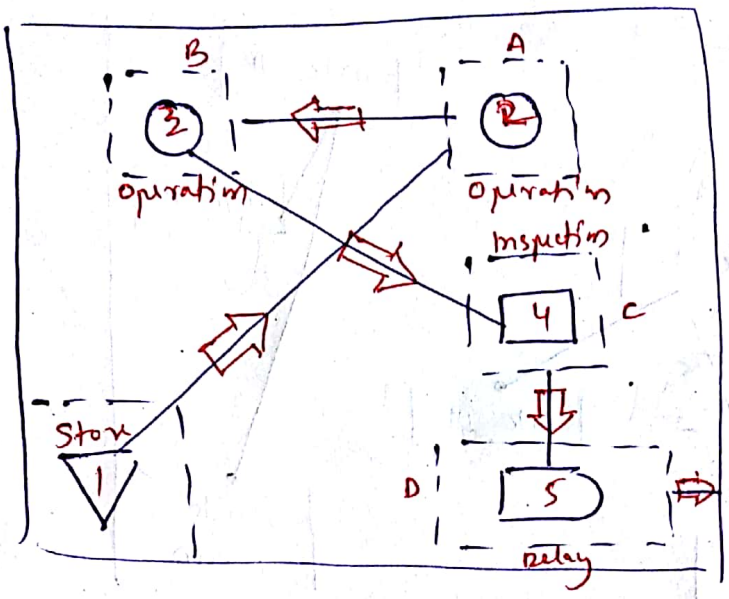

STRING DIG.

→ A string dig: is layout drawing on which the length of string is utilised to record the extent as well as pattern of movement of operators, material, machine working in a limited period.

→ When paths are many & repetitive, a flow dig. becomes congested & it will be difficult to understand. In such condition, the string dig. is preferred.

→ String dig is a scale plan of the shop on which length of string is used to record the extent.

→ It provides the actual distance travelled during the period of study.

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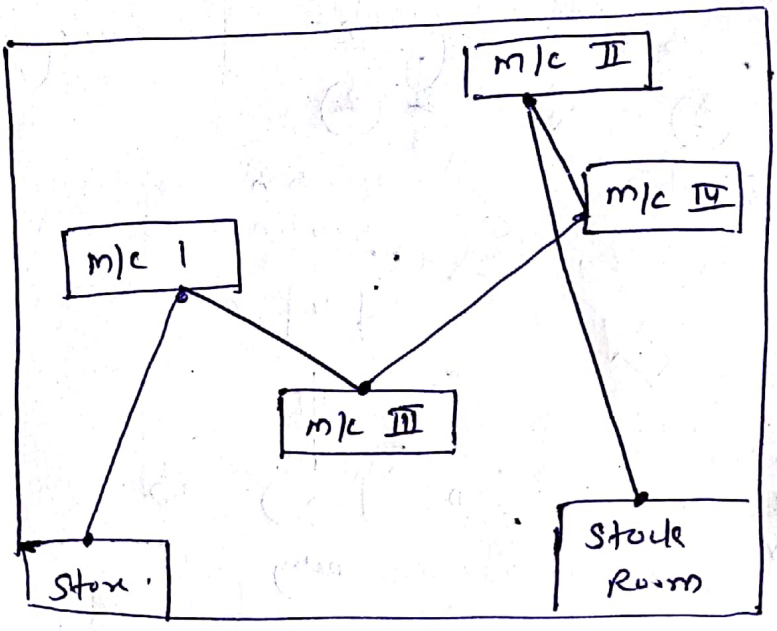

adv.

1) It is useful in such cases, where there are many paths of a repetitive nature.

2) It indicates clearly the backtracking, over utilised paths, under-utilised paths.

3) It is very helpful in deciding the most economical routes to do a particular operation.

TRAVEL CHARTS

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TRAVEL CHART

UNIT-3

→ Travel chart is quicker & more manageble recording technique.

→ A ~~Tabular~~ Travel chart is a tabular record for presenting quantitative data about the movement of workers, materials or equipment b/w any no. of places over a given period of Time.

→ Travel chart is of square shape, having small squares within the main square.

→ Each small square represents a work station.

→ Due to Involvements of many complex movement in string diagram it becomes very complicated, So In such condition we use Travel chart.

Models

Sometime when the picture of existing condition is not clear by the use of process chart or flow diagram, models are used to provide visual representation of proposed layout before proceeding the actual arrangement of the Workplace.

Types —
- → 2D Model
- → 3D Model

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2D Model :-

Two dimensional models are used for various machines, equipment & benches.

→ These are made from cardboard, plywood or plastic sheets.

→ With the help of 2D model, there is a saving of lot of time.

ii) 3D Model :-

These are three dimensional model or Block model represent the real situation because besides length & width they show the height of facility also.

→ These models are useful in industries, plant, flour mill etc.

MOTION STUDY

→ Initiated by Frank Gilbreth & his wife Lillian Gilbreth.

Motion study is a device of work Improvement or work simplification.

→ Motion study is a scientific way of determining the best method of doing work with the help of a close security of the motions made by a worker or machine.

→ The aim of motion study is to find scheme of least wasteful method of labour.

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Therbligs

The analysis of breakdown of a task into basic elements of motion is called 'THERBLIGS'.

Therblig analysis

Gilberth's System of Therbligs

- Search
- Find
- Select
- Grasp
- Position
- Transport loaded
- Assemble
- Use
- Disassemble or take part
- Inspect
- Prepare for next operation
- Release load
- Transport empty
- Wait (an unavoidable delay)
- Wait (A.D)
- Rest
- Plan

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Micromotion study (objective, steps)

- Micromotion study is a set of technique intended to divide human activities into groups of movements or micromotions.

→ Micromotion study technique is best suited for those operation which are short in cycle & which are repeated thousand of times.

→ It is the study of movement to find one best pattern of movements that consume less time & require less effort to accomplish the task.

→ It is the study of fundamental element of an operation with the help of a high speed movie camera in order to eliminate the unnecessary motion involved in operation & balancing necessary motion.

objectives

i) To assists in finding the most efficient way of doing a work.

ii) To help to study repetitive short cycle operation which cannot be studied by ordinary methods.

iii) To train the operator regarding the motion economy.

(iv) To assist in research ~~work~~ projects in the field of work study.

(v) To keep record of method.

(vi) It helps to study complex activities of short duration performed with extreme rapidity.

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Steps In Micromotion study :-

1) Filming the operation to be studied
2) Analysing the film
3) Charting the results of analysis (graphic representation).
4) Developing an Improved method.

Equipment Required for filming the Operations -

1) Movie Camera
2) 16 mm film - Used for Recording both sound & vision.
3) Microchronometer / Wink counter - It is a digital device, thus it read quickly. It is a timing device.
4) Exposure metre - to determine exposure.
5) Flood light & reflectors.
6) Motion picture projector with screen.

Principles of Motion Economy → It is developed to achieve synchronisation of human body movements, best layout of workplace & optimum design of equipment.

→ There are five basic principle -

→ Principle of (i) minimum movement (ii) Simultaneous & Symmetrical movement (iii) Rhythmic movement

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Quality Management

→ What is quality ?

Quality is the totality of features & characteristics of a product or service that bear on its ability to satisfy a given need.

OR

Quality Refers to an equilibrium level of functionality possessed by a product or service based on the producer's capability & Customer's need.

→ Quality generally signifies "excellence" of a product or service.

→ Quality is what Customer wants.

Dimension of quality

1) Performance
2) Features
3) Durability
4) Reliability
5) Serviceability
6) Appearance
7) Uniformity
8) Consistency & Conformance
9) Safety
10) Time
11) Customer Service
12) Compatibility

→ According to International Organisation of Standardisation (ISO) " Quality means the totality of features & characteristic of a product or service that bear on its ability to satisfy implied needs".

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Factors Influencing quality

i) Technological advancement → It includes degree of mechanisation, technical knowhow, product design etc.

ii) Quality of Human Resources –

- quality of worker
- willingness of the worker
- The environment under which he has to work.

iii) Availability of funds

iv) Management Commitment

v) Natural factors

Steps to Improve quality

i) Improved Raw materials

ii) Better technology

iii) Scientific selection of workers

iv) Good Working conditions

v) Harmonious Relations

vi) Quality & Cost Consciousness

vii) Industrial Research.

Quality Control

Control of quality deals with the determination of quality standards & measurment & control messag to see that the established standards are maintained & Practised.

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→ Quality control is the function of ensuring that the product quality conforms to predetermined standards.

Areas of application of Quality Control

i) Products
ii) Processes
iii) People → (employee)

Control Charts

A control chart is a statistical tool for indicating variations in quality from standards.

→ Control charts are used for controlling the quality of manufacturing operations as well as finished products.

→ They are used for variable & attribute control.

→ Control charts — (I) Mean ($\bar{X}$) chart
(II) Range (R) chart
(III) Defective (P) chart
(IV) Defects per Unit (c) chart.

Types of Control charts

(I) Control Charts for Variables — These charts are used to achieve & maintain quality level for a process, whose o/p product can be subjected to quantitative measurement & dimensional check.

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2) <u>Control Chart for attributes</u> – These charts are used to achieve & maintain an acceptable quality level for a process whose o/p products are not subjected to dimensional or quantitative measurment but can be classified as <u>good or bad</u> & <u>acceptable</u> or <u>non-acceptable</u>.

- Control Chart
  - Control Chart for Variables
    - $\bar{X}$ Chart
    - R Chart
    - σ or S chart
  - Control chart for attributes
    - P chart
    - np Chart
    - C chart
    - U chart

i) <u>Control Chart for Variables</u>

→ It is generally based on mean ($\bar{X}$) or range (R) of sample measurment.

→ <u>R chart</u> → When the quality controller is intrested in the range of differences b/w the largest & when the quality controller is intrested in largest & smallest measurments, then we use <u>R chart</u>.

→ It shows the variation in the range of sample. This chart is a measure of spread of samples.

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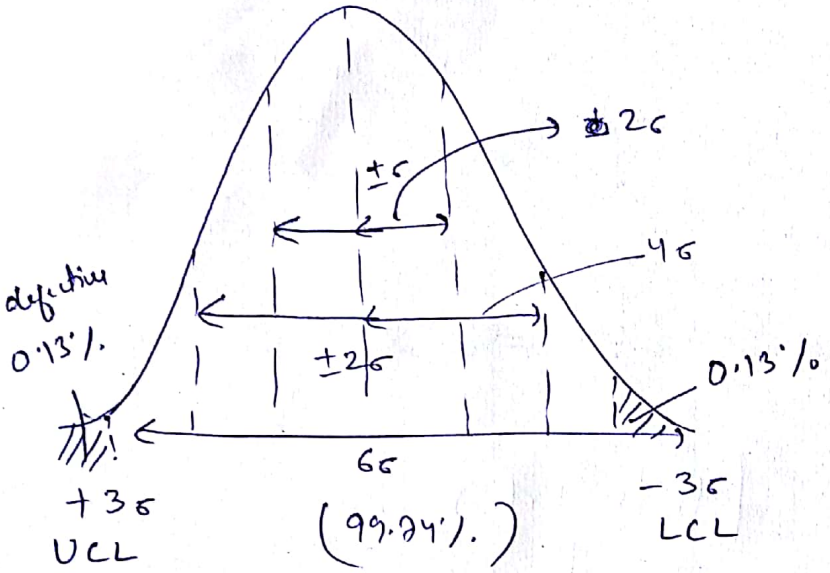

UCL = upper control limit

LCL = lower control limit.

↳ 99.74% of items falls within this region.)
So only 0.26% defective items are produced on a longer run.

$\bar{X}$ Chart → It shows the centre of the process or in other words it shows the variation in the avg. sample.

Sample No.	Item No. 1	2	3	4	Sample mean ($\bar{x}_i$)
1	11	12	13	14	$\frac{11+12+13+14}{4}$ = ___
2	15	16	17	18	$\frac{15+16+17+18}{4}$ = ___
⋮	⋮	⋮	⋮	⋮	⋮
n	⋮	⋮	⋮	⋮	average ($\bar{\bar{x}}_i$) = ___

σ_p = ~~[illegible]~~ average proportion of standard deviation

σ = std. deviation

$$\sigma_p = \sqrt{\frac{\Sigma(\bar{x}_i - \bar{\bar{x}}_i)^2}{n}}$$

$$UCL = \bar{\bar{x}}_i + 3\sigma_p$$

$$LCL = \bar{\bar{x}}_i - 3\sigma_p$$

where, n = sample size, $\bar{x}_i$ = sample mean

$\bar{\bar{x}}_i$ = avg. sample mean

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(ii) R- Chart → It shows the variation in the range of sample. This chart is measure of spread of the samples.

Sample No.	Item No. 1	2	3	4	Sample Range (R_i)
1	10	20	30	40	Max value - min value 40 - 10 = 30
2	⋮	⋮	⋮	⋮	⋮
3	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
n					average ($\bar{R}_i$) =

$$\sigma_p = \sqrt{\frac{\Sigma(R_i - \bar{R}_i)^2}{n}}$$

$$UCL = \bar{R}_i + 3\sigma_p$$

$$LCL = 0$$

or $LCL = \bar{R}_i - 3\sigma_p$

where, n = Sample size R_i = Sample range

$\bar{R}_i$ = average Range

Control Chart for Attributes

(1) P- Chart → It is also known as fraction or proportion defective chart. It is used for the situation when sample size is not constant.

Sample no.	No. of Inspected / Sample size	no. of defective	Proportion defective
1	n_1	d_1	$p_1 = \frac{d_1}{n_1}$
2	n_2	d_2	$p_2 = \frac{d_2}{n_2}$
⋮	⋮	⋮	⋮
N	n_N	d_N	$p_N = \frac{d_N}{n_N}$

$$\text{average Sample Size } (n) = \frac{n_1 + n_2 + \dots n_N}{N}$$

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average proportion defective $(\bar{p}) = \dfrac{p_1 + p_2 - - - p_N}{N}$

$$\boxed{\sigma_p = \sqrt{\frac{\bar{p}(1-\bar{p})}{n}}}$$

$$\boxed{UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}}$$

$$\boxed{LCL = 0}$$

or $LCL = \bar{p} - 3\sqrt{\dfrac{\bar{p}(1-\bar{p})}{n}}$

where $\bar{p}$ = avg. proportion defective

σ_p = Standard deviation of avg. proportion.

n = avg. Sample Size

(ii) <u>np chart</u> – It is also known as no. of defective chart & is used for the situation where sample size is constant.

Sample No.	Sample Size	No. of defective	Proportion defective
1	n_1	d_1	$p_1 = \dfrac{d_1}{n}$
2	n_2	d_2	$p_2 = \dfrac{d_2}{n}$
⋮	n	⋮	⋮
N	n	d_n	$p_N = \dfrac{d_N}{n}$

$$\boxed{\sigma_p = \sqrt{\frac{\bar{p}(1-\bar{p})}{n}}}$$

$\bar{p}$ – as same in p chart we have used.

$$\boxed{UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}}$$

$$\boxed{LCL = 0}$$

or $LCL = \bar{p} - 3\sqrt{\dfrac{\bar{p}(1-\bar{p})}{n}}$

(iii) <u>C - Chart</u> → It is also known as count of defect chart & it is used when we can compute only the no. of defects but cannot compute the proportion that is defective.

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lot No.	defects
1	d_1
2	d_2
⋮	⋮
N	d_N

average no. of defect count $(\bar{c})$ =

$$(\bar{c}) = \frac{\text{sum of defect count } (d_N)}{N}$$

$$\boxed{\sigma = \sqrt{\bar{c}}}$$

$$\boxed{UCL = \bar{c} + 3\sqrt{\bar{c}}}$$

$$\boxed{LCL = \bar{c} - 3\sqrt{\bar{c}}}$$

ZERO DEFECT

Zero defect means that even if there a single defective unit in the sample of manufactured parts or products, the whole lot is rejected.

→ The purpose is to motivate the workers & supervisiors to manufacture flawless products in the first instance so that there are no rejections, & the company is able to create an image for high quality products.

→ The idea is to create among workers & supervisiors pride in workmanship & build quality consiousness.

→ For achieving zero defects production may also tempt engineers to set loose tolerances which may result into production of sub-standard products.

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Total Quality Management (TQM)

TQM may be defined as creating an organisational culture committed to the continious improvement of skills, teamwork, processes, product & service quality & customer satisfaction.

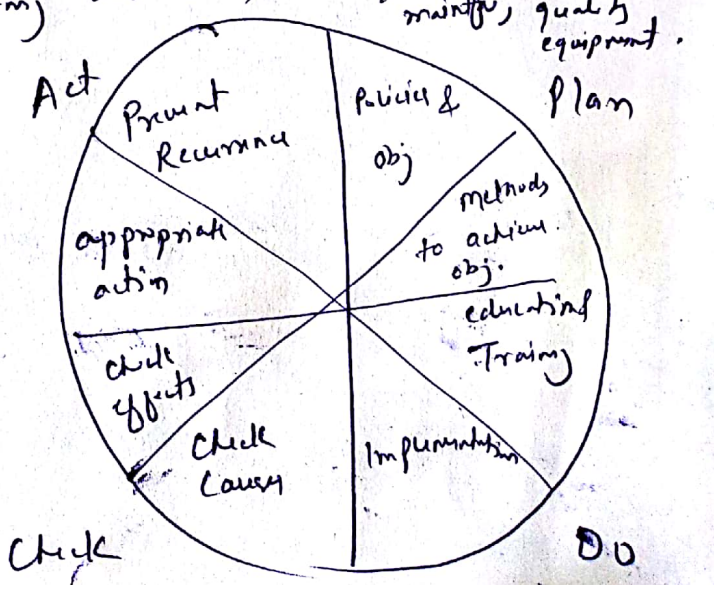
→ TQM is an effective system of integrating quality developments, quality maintenance, quality improvement efforts of various group in an organisation.

→ For achieving total quality, three things are essentials –

(i) meeting customer's requirement
(ii) Continious improvement through management process
(iii) Involvement of all employees.

Roadmap of TQM

(i) Quality Planning
(ii) Quality Implimentation – Performing lab tests, analysis of raw materials, maintain quality equipment.
(iii) Quality monitoring (control)



Steps In TQM

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Taguchi Philosophy

Genichi Taguchi proposed that it is not sufficient to control process, inspect quality o/p, identify & remove defects & rely on customer feedback, so he suggested that to improve quality, one must look upstream at the design stage cz that is where quality begins.

→ Taguchi developed quality engineering an approach that involves combining engineering & statistical method to reduce costs & improve quality to be optimising product design & manufacturing process.

Taguchi Quality Loss function

→ Taguchi quality loss function estimates the loss to society from the failure of a product to meet its target value for a particular performance characteristic.

→ It is a statement that any deviation from the target value of a quality characteristic results in extra costs to some segment of society.

→ Taguchi defines quality in terms of social loss, loss to producers & consumers from the time a product is conceived.

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→ Quality loss function is expressed as –

$$\boxed{L = c(X - T^2)} \quad - (1)$$

c = a cost Const.

where, L = Total loss

x = actual avg. value of quality characteristic.

T = Target value of quality characteristic.

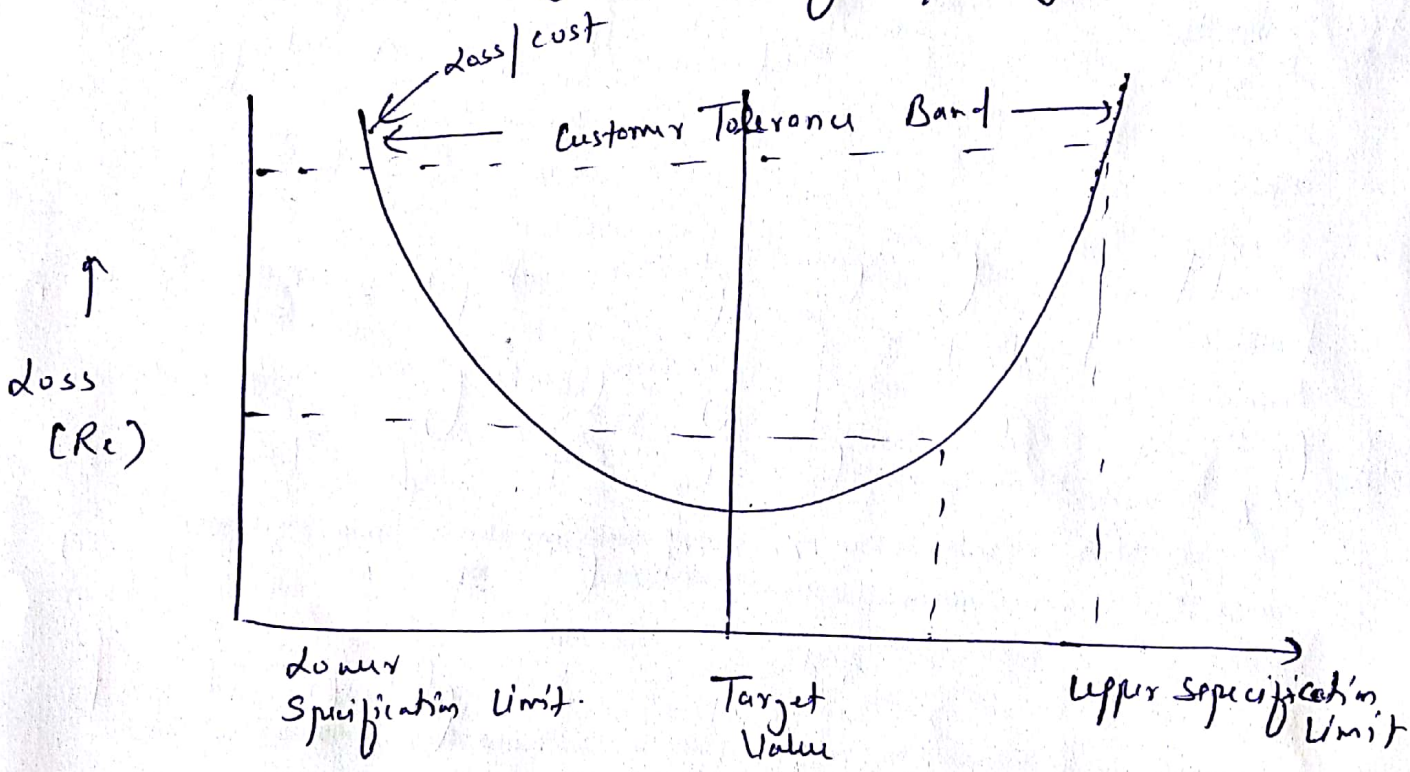

Fig :- Taguchi's quality loss function

→ eqn (1) shows that the loss from performance variation (L) is directly related to the square of the deviation (d) of the performance characteristic (X) from its ~~dem~~ target value (T).

i.e. $L = cd^2$

or $L = c(X-T)^2$

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Service Quality

Service quality includes both quality of core services & facilitating services which enhance the value of core services of customer.

Component of Service quality System

(i) The two key components of service system quality are –

(I) Employees

(II) Information Technology

"If we take care of our employee, they will take care of our customers".

SIX SIGMA

→ Six Sigma implies maintenance of the desired quality in processes & end products.

→ It means taking systematic & integrated efforts towards improving quality & reducing cost.

→ Six Sigma is a highly disciplined process that helps in developing & delivering near perfect product & service.

Three Main areas of Six Sigma –

(I) Improving Customer Satisfaction

(II) Reducing Cycle Time

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(iii) Reducing defects.

Six Sigma Methodology

DMAIC

- Define
- Measure
- Analyze
- Improve
- Control

DMADV

- Define
- Measure
- Analyse
- Design
- Verify

discuss These process in brief

DMAIC → It is methodology acronym for five diff. steps used in six Sigma directed towards Improvement of existing products, process or service.

DMADV → DMADV is again acronym for the step followed in Implementing Six Sigma. It is a strategy for designing new products, process & services.

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