Unit - 4

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".

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 & measurement & control necessary to see that the established standards are maintained & Practised.

→ 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.

2) Control Chart for attributes - 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 good or bad & acceptable or non-acceptable.

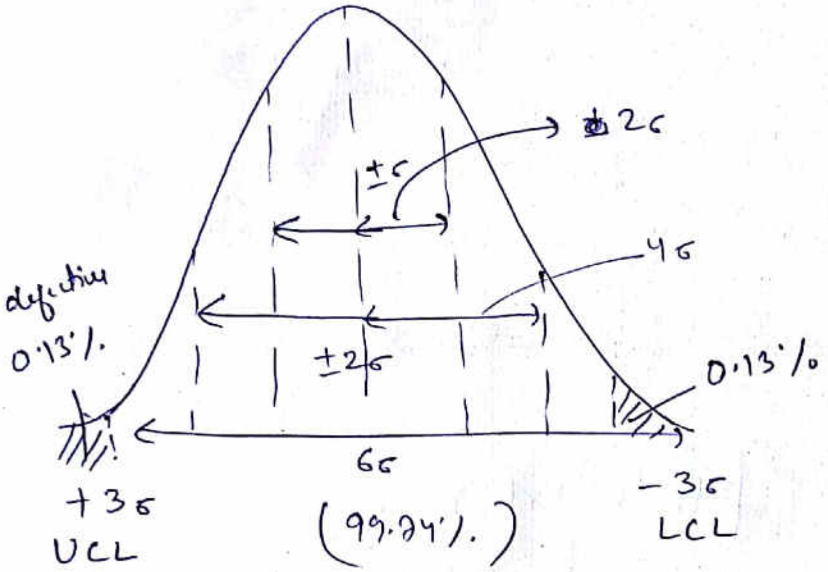
- Control Chart
  - Control Chart for Variables
    - $\bar{X}$ Chart
    - R Chart
    - σ or S chart
  - Control chart for attributes
    - P chart
    - np Chart
    - C chart
    - U Chart

i) Control Chart for Variables

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

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

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



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 centring 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 = average proportion of standard deviation

σ = std. deviation

$$\boxed{\sigma_p = \sqrt{\frac{\sum(\bar{X}_i - \bar{\bar{X}}_i)^2}{n}}}$$

$$\boxed{UCL = \bar{\bar{X}}_i + 3\sigma_p}$$

$$\boxed{LCL = \bar{\bar{X}}_i - 3\sigma_p}$$

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

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

(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 ($\bar{R}_i$) =

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

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

$$\boxed{LCL = 0}$$

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

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	$p_N = \frac{d_N}{n_N}$

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

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

when $\bar{P}$ = avg. proportion defective

σ_p = Standard deviation of avg. proportion.

n = avg. Sample Size

(II) np chart – It is also known as no. of defective chart & is used for the situation when sample size is constant.

Sample No.	Sample Size	No. of defective	Proportion defective
1	n	d_1	$P_1 = \dfrac{d_1}{n}$
2	n	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) C – Chart → It is also known as count of defect chart & it is used when we can compute only the no. of defects but can not compute the proportion that is defective.

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.

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 Implementation – Performing lab tests, analysis of raw materials, maintaining quality equipment.
(III) Quality monitoring Control

Steps In TQM

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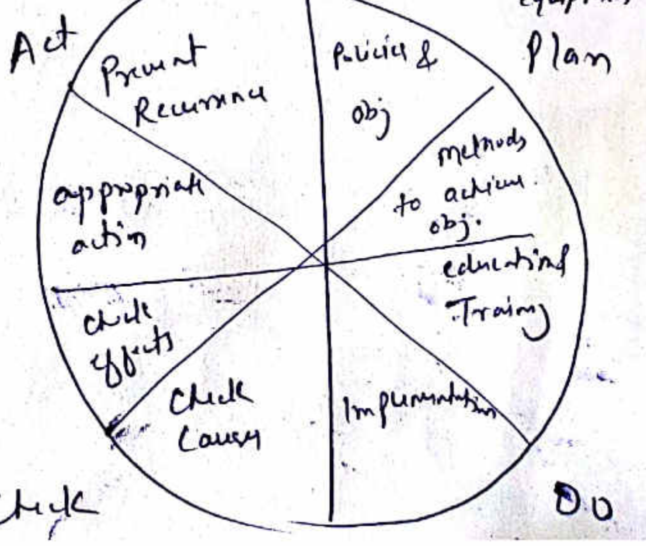

Taguchi Philosophy

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 as that is where quality begins.

→ Taguchi developed quality engineering an approach that involves combining engineering & stastical 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.

→ Quality loss function is expressed as –

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

where, L = Total loss
C = a cost const.
x = actual avg. value of quality characteristic.
T = Target value of quality characteristic.

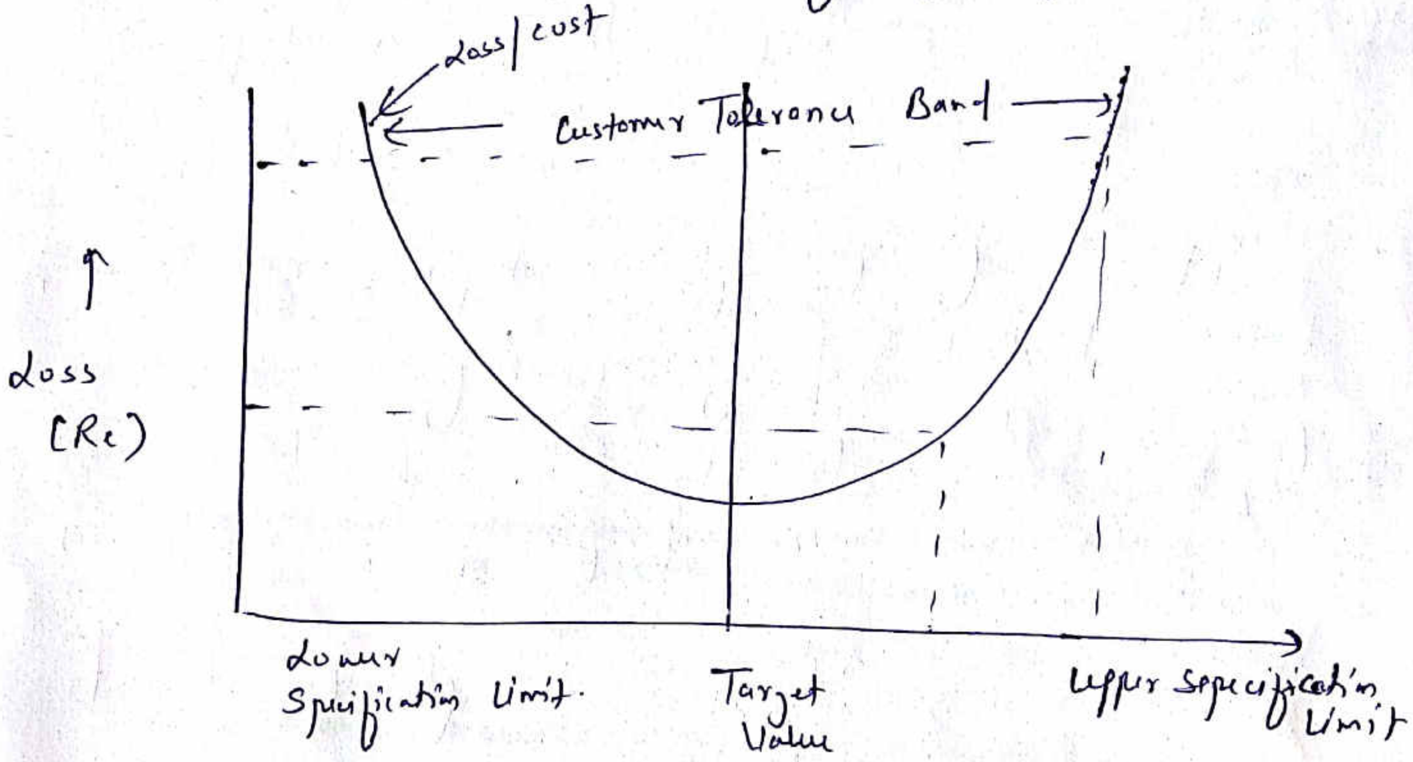

Fig :- Taguchi's quality loss function

→ 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 ~~own~~ target value (T).

i.e. $L = Cd^2$
or $L = C(X-T)^2$

Service Quality

Service quality Includes both quality of core services & facilating services which enhance the value of core services of customer.

Component of Service quality System

(iii) 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 & services.

Three Main areas of Six Sigma –

(i) Improving Customer Satisfaction

(ii) Reducing Cycle Time

(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.