

UNIT - I

INTRODUCTION

INTRODUCTION:

DESCRIPTION OF TQM:

Total - Made up of the whole.

Quality - Degree of Excellence a product (or) service provides.

Management - Act, art (or) manual of handling, controlling, directing etc;

∴ TQM is the art of managing the whole to achieve excellence.

DEFINITION: (ISO).

"TQM is the management approach of an organization, centred on quality, based on participation of all its members & aiming at long term success through customer satisfaction & benefits to all members of the organization and to society".

CHARACTERISTICS:

→ Customer oriented.

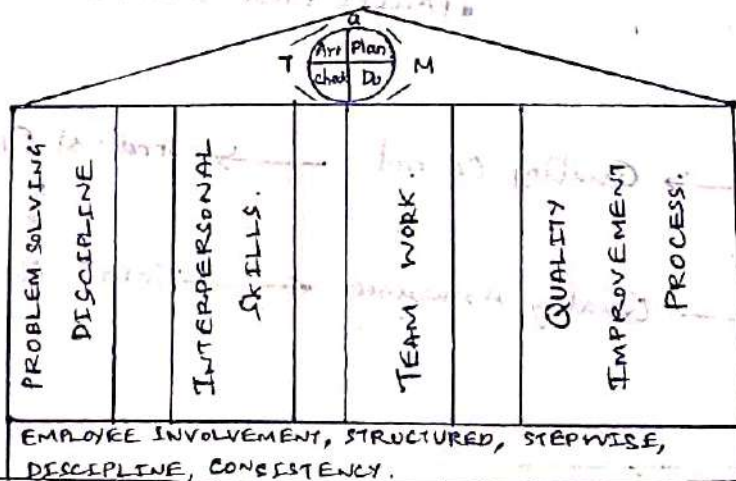
→ Long-term Commitment for Continuous improvement of all processes.

→ Team work.

→ It requires the leadership of Top Management and continuous involvement.

→ It is a strategy for Continuous improving performance at all levels and in all area of responsibility.

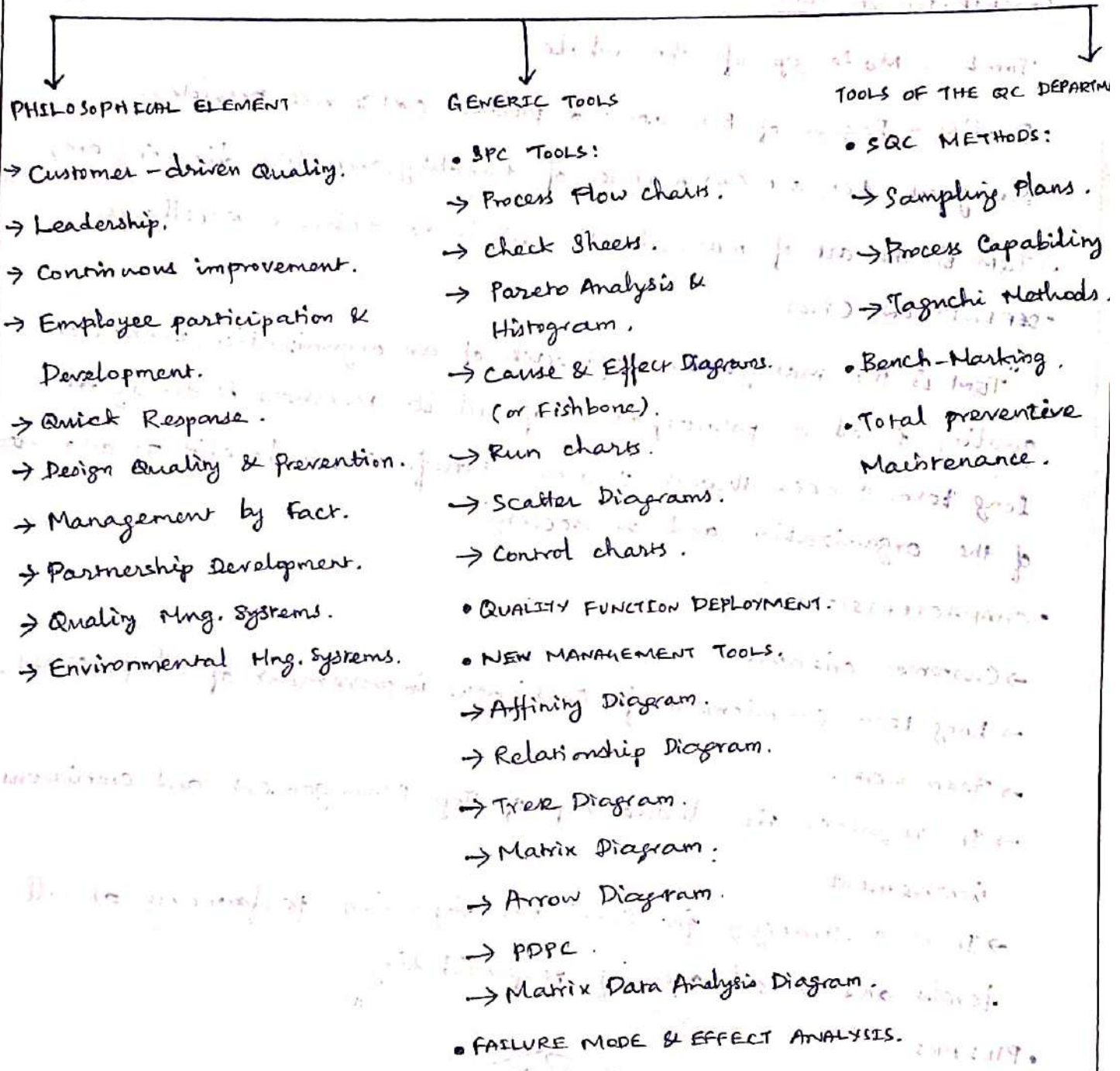
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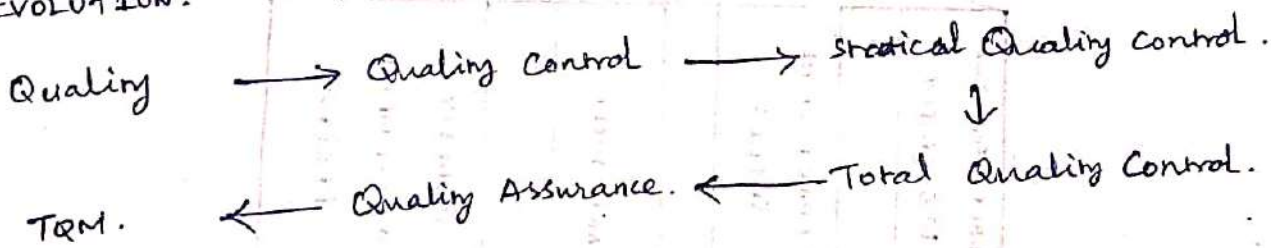
• ELEMENTS:

TQM

Managing the entire organization so that it excels in all dimensions of Products & services that are important to the customer.



• EVOLUTION:



PRINCIPLES OF TQM

[Nov/DEC-2016]

- (i) Customer requirements must be met the first time, every time.
- (ii) There must be agreed requirements, for both internal & external customers.
- (iii) Everybody must be involved, from all levels & across all functions.
- (iv) Regular communication (both formally & informally) with staff at all levels is must. Two-way communication at all levels must be promoted.
- (v) Identifying training needs & relating them with individual capabilities & requirements is must.
- (vi) Top management's participation & commitment is must.
 - (i) A culture of continuous improvement must be established.
 - (ii) Emphasis should be placed on purchasing & supplier management.
 - (iii) Enjoy job must add value.
 - (iv) Quality improvement must eliminate wastes & reduce total cost.
 - (v) There must be a focus on the prevention of problems.
 - (vi) A culture of promoting creativity must be established.
 - (vii) Performance measures is a must at organization, department & individual levels.
 - It helps to assess & meet objectives of quality.
 - (viii) There should be focus on team work.

POTENTIAL BENEFITS:

<u>Tangible</u>	<u>Im-tangible</u>
<ul style="list-style-type: none">✓ Improved product quality.✓ Improved productivity.- Reduced quality costs.✓ Increased market & customers.- Increased profitability.- Reduced employee grievances.	<ul style="list-style-type: none">✓ Improved employee participation.✓ Improved teamwork.✓ Improved working relationships.✓ Improved customer satisfaction.✓ Improved communication.- Enhancement of job interest.- Enhanced problem-solving capacity.✓ Better company image.

• QUALITY:

- ✓ Deming - It is a predictable degree of uniformity & dependability at low cost & suited to the market.
- ✓ Juran - It is fitness for use.
- ✓ Crosby - It is conformance to requirements.
- ✓ Taguchi - It is the loss imparted by a product to society from the time the product is shipped.
- ✓ Feigenbaum - It is in its essence, a way of managing the organization.
- ✓ Hoshin - It is correcting & preventing loss, not living with loss.
- ✓ ISO - "It is the totality of characteristics of an entity that bear on its ability to satisfy stated & implied needs".
- ✓ Quality can be quantified as follows:
$$Q = \frac{P}{E} \Rightarrow \frac{\text{Performance}}{\text{Expectations}}$$

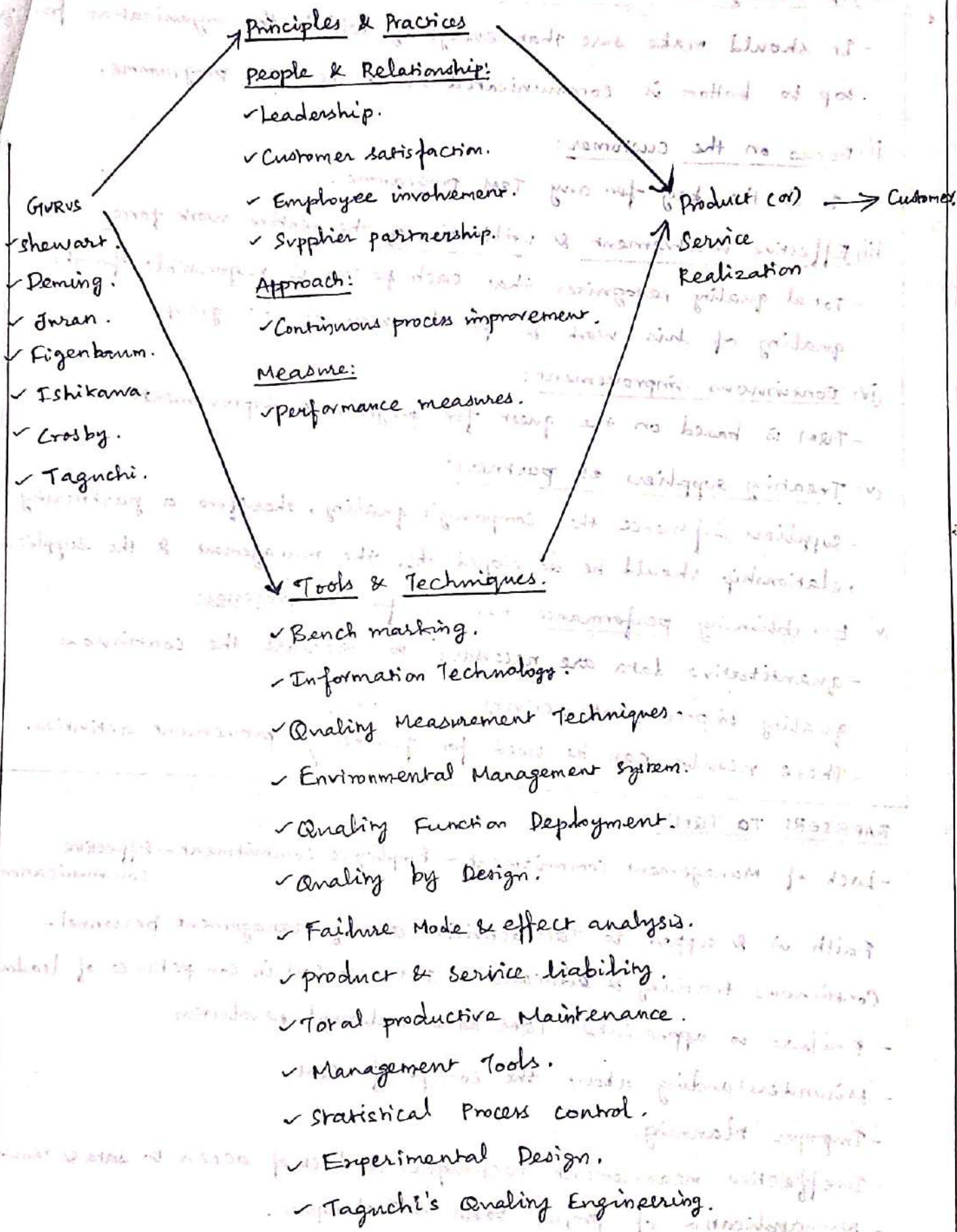
Need for Quality:

Reasons for quality becoming a leading priority for most organizations.

- Competition.
- Changing customer.
- Changing product mix.
- Product complexity.
- Higher level of customer satisfaction.

TQM Framework: [APRIL/MAY - 2015]

agenda



GURUS

- ✓ Shewart.
- ✓ Deming.
- ✓ Juran.
- ✓ Figenbaum.
- ✓ Ishikawa.
- ✓ Crosby.
- ✓ Taguchi.

Principles & Practices

People & Relationship:

- ✓ Leadership.
- ✓ Customer satisfaction.
- ✓ Employee involvement.
- ✓ Supplier partnership.

Approach:

- ✓ Continuous process improvement.

Measure:

- ✓ performance measures.

Tools & Techniques.

- ✓ Bench marking.
- ✓ Information Technology.
- ✓ Quality Measurement Techniques.
- ✓ Environmental Management system.
- ✓ Quality Function Deployment.
- ✓ Quality by Design.
- ✓ Failure Mode & effect analysis.
- ✓ product & service liability.
- ✓ Total productive Maintenance.
- ✓ Management Tools.
- ✓ Statistical Process control.
- ✓ Experimental Design.
- ✓ Taguchi's Quality Engineering.

Product (or)

Service Realization

Customer

BASIC CONCEPTS OF TQM:

(i) Top Management Commitment:

- It should make sure that everybody within the organisation from top to bottom is communicated about the TQM programme.

(ii) Focus on the customer:

- It is the key for any TQM programme.

(iii) Effective involvement & utilisation of the entire work force:

- Total quality recognises that each person is responsible for the quality of his work & for the work of the group.

(iv) Continuous improvement:

- TQM is based on the quest for progress & improvement.

(v) Treating suppliers as partners:

- Suppliers influence the company's quality, therefore a partnering relationship should be developed b/w the management & the suppliers.

(vi) Establishing performance measures for the processes:

- Quantitative data are necessary to measure the continuous quality improvement activity.
- These results can be used for further improvement activities.

15. b) BARRIERS TO TQM:

[MAY/JUNE - 2013]

[11. b. ii), APRIL - 2014]

- Lack of Management Commitment - Employee Commitment - Effective Communication.

Faith in & support to TQM activities among management personnel -

Continuous training & education - Interest (or) in-competence of leaders.

- Failure to appreciate TQM as a cultural revolution.

- Misunderstanding about the concept of TQM.

- Improper planning.

- Ineffective measurement techniques & Lack of access to data & results.

- Non-application of proper tools & techniques.

- Inadequate use of empowerment & team work → Attention to internal & external customers.

Delay (or) non-implementation of quality improvement team's re-recommendations.

EVOLUTION OF QUALITY:

[MAY/JUNE - 2013]

Inspection	Salvage, sorting, grading, blending, corrective actions, identify sources of non-conformance.
Quality Control	Develop quality manual, process performance data, self-inspection, product testing, basic quality planning, use of basic statistics, paperwork control.
Quality Assurance	Quality systems development, advanced quality planning, comprehensive quality manuals, use of quality costs, involvement of non-production operations, failure mode effect analysis, SPC
TQM.	Policy deployment, involve supplier & customers, involve all operations, process management, performance measurement, teamwork, employee involvement.

Time	Events.
Prior to the 20 th Century	Until 1960's. <ul style="list-style-type: none"> • Quality is an art. • Demands overcome potential production • An era of workmanship.
F. Taylor 1900's	• The scientific approach to management resulting in rationalization of work & its breakdown leads to greater need for standardization, inspection & supervision.

<u>TIME</u>	<u>EVENTS.</u>
Shewart 1930's Late	<p>Statistical beginnings & study of quality control.</p> <ul style="list-style-type: none"> • A Fisher on experimental design, • the beginning of control charts at Western Electric in USA. • Quality standards & approaches are introduced in France & Japan.
1930's	<ul style="list-style-type: none"> • Beginning of SQC reliability & Maintenance Engineering.
1944	<ul style="list-style-type: none"> • Dodge & Deming carried out seminal research on acceptance sampling.
1945	<ul style="list-style-type: none"> • Founding of the Japan standard association.
1946	<ul style="list-style-type: none"> • Founding of the ASQC.
1950	<ul style="list-style-type: none"> • Visit of Deming in Japan at the invitation of Kishikawa.
1951	<ul style="list-style-type: none"> • Quality assurance increasingly accepted.
After 1960's. 1961	<ul style="list-style-type: none"> • The martin Co in USA introduces the zero defects approach while developing & producing perishing Missiles. • Quality motivation is starting in the US & integrated programmes begun.

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<u>TIME</u>	<u>EVENTS.</u>
1964	<ul style="list-style-type: none">• Ishikawa publishes book on quality Management.
1970	<ul style="list-style-type: none">• Ishikawa published the book on the basis of quality circles & the concept of Total quality is affirmed & devised in Japanese industries.
1970 to 1980	<ul style="list-style-type: none">• Just-in-Time & quality become crucial for competitiveness.• A large number of US & European corporations are beginning to appreciate the advance of Japan's industries.• Taguchi popularizes the use of environmental design to design robust systems & products.
1980 +	<ul style="list-style-type: none">• Facing the rising sun challenge in quality management.• Development & introduction of FMS's & greater dependance on supplier contracts.• Growth of economic based on quality control, information software packages.
1990 +	<ul style="list-style-type: none">• The management of quality has become a necessity that is recognized at all levels of management.• Increasing importance is given to off line quality management for the design of robust manufacturing processes.

DEMING'S 14 POINTS ON ROUTE TO QUALITY!

- (i) Create Constancy of purpose toward improvement of product & service.
 - with the aim to become competitive & to stay in business, & to provide jobs.
- (ii) Adopt the new philosophy
 - Must learn their responsibilities & take on leadership for change.
- (iii) Cease dependence on inspection to achieve quality.
 - Eliminate the need for inspection on a mass basis by building quality into the product in the first place.
- (iv) End the practice of awarding business on the basis of price tag.
 - Instead, minimize total cost.
 - Move toward a single supplier for any one item, on a long-term relationship of loyalty & trust.
- (v) Improve constantly & forever the system of production & service.
 - To improve quality & productivity, & thus constantly decrease costs.
- (vi) Institute training on the job.
- (vii) Institute leadership.
 - The aim of supervision should be to help people & machines & gadgets to do a better job.
- (viii) Drive out fear.
 - so that everyone may work effectively for the company.
- (ix) Break down barriers b/w departments.
 - It may be encountered with the product (or) service.
- (x) Eliminate slogans, exhortations, & targets for the work force.
 - which ask for zero defects & new levels of productivity.
- (xi) Eliminate work standards (quotas) on the factory floor.
 - substitute leadership.

- Eliminate management by objectives.

- Eliminate management by Numbers, numerical goals, substitute

(xii) Remove barriers to pride of workmanship.

- the responsibility of supervisors must be changed from sheer drive to quality.

- Abolishment of annual (or) merit rating & of management by objectives

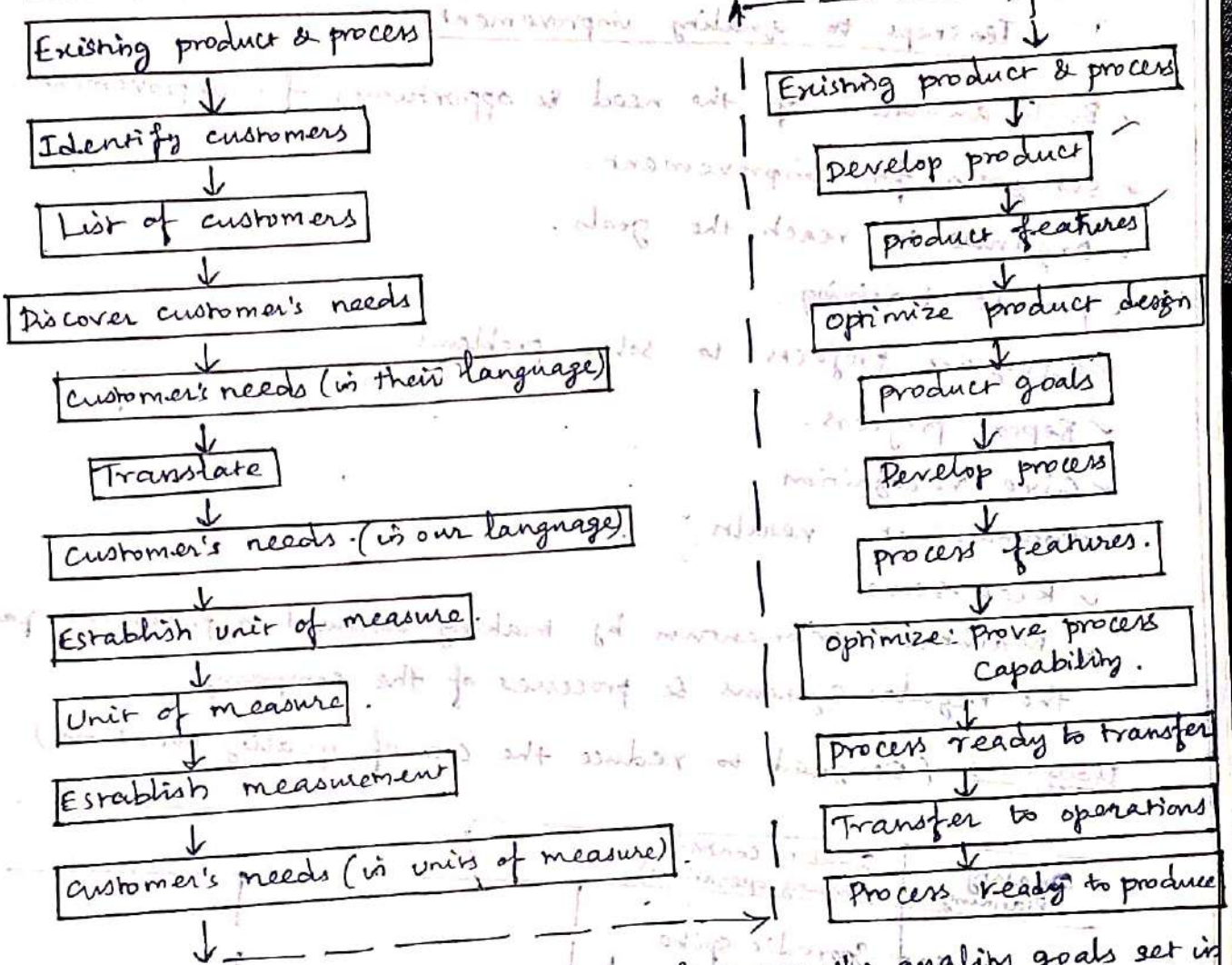
(xiii) Institute a vigorous program of education & self-improvement

(xiv) Accomplish the transformation.

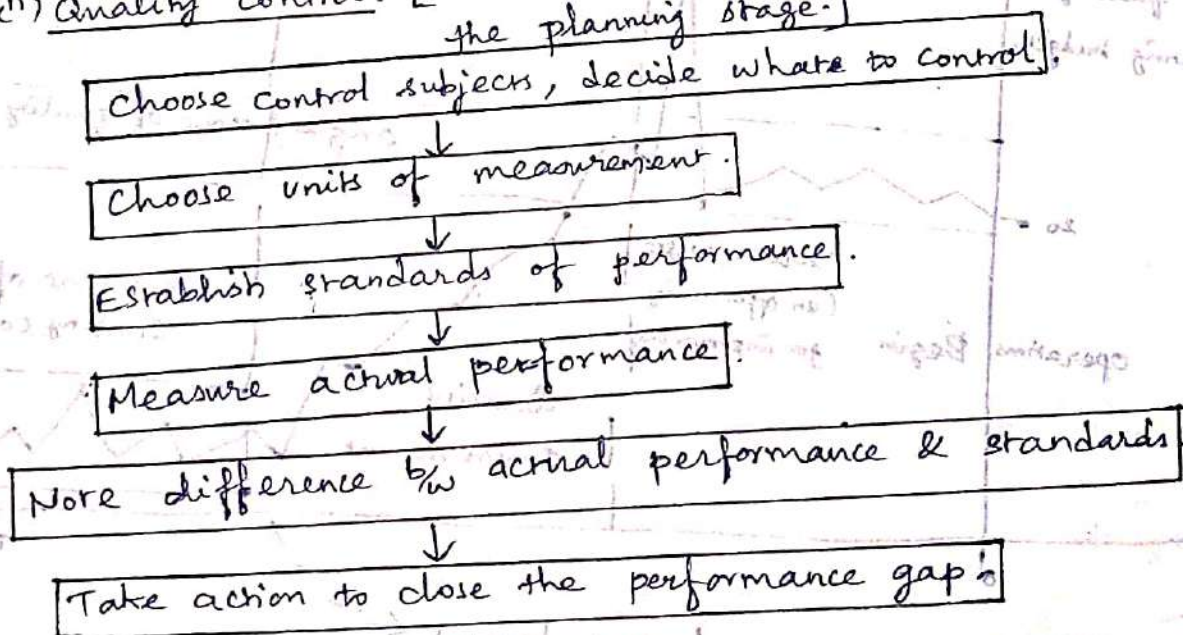
- put everybody in the company to work to accomplish the transformation (everyone's job.)

Juran divides management into three parts. They are,

(i) Quality planning: [An organisation prepares to meet established quality goals.]



(ii) Quality control: [Designed to meet & ensure the quality goals set in the planning stage.]



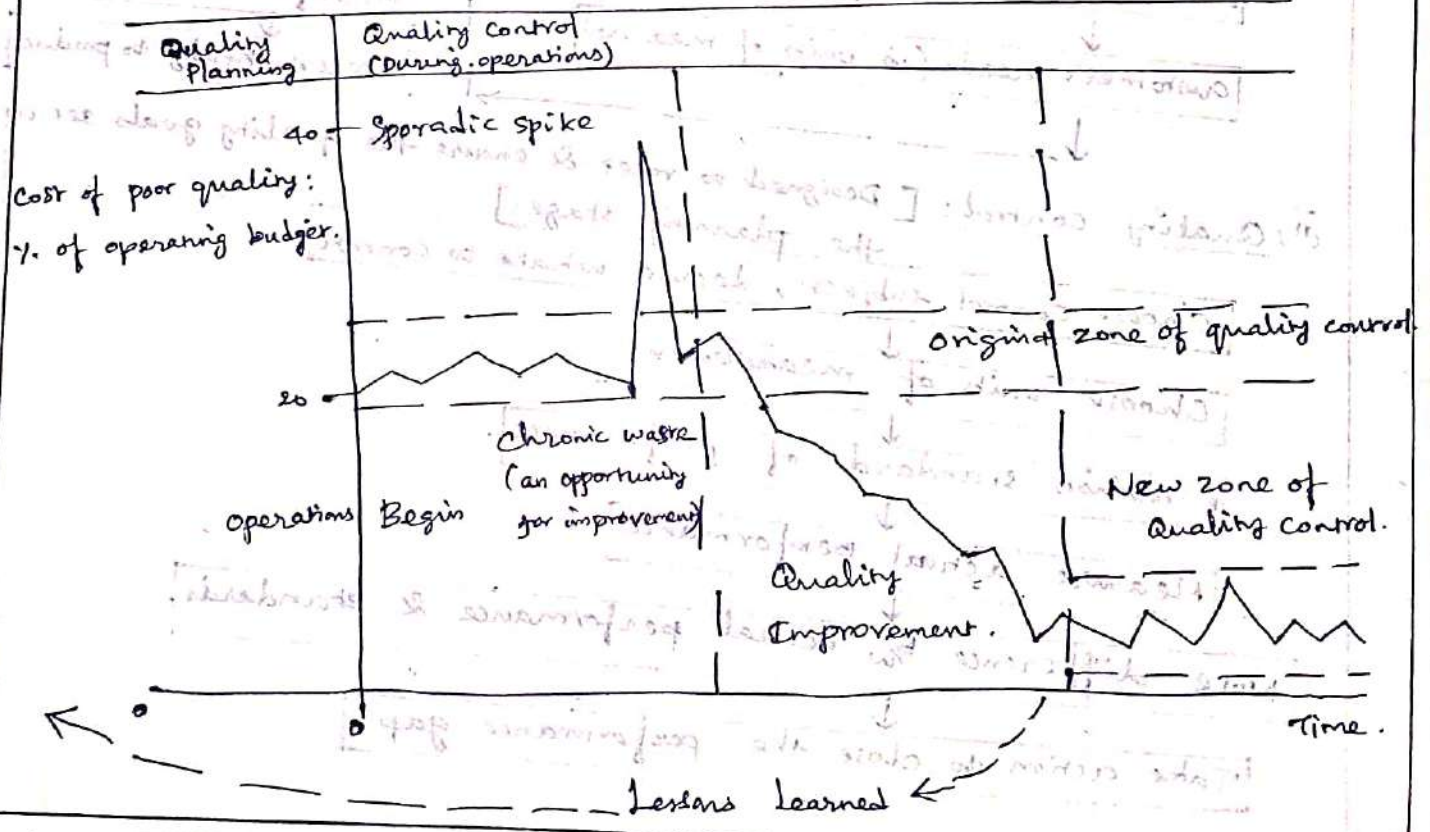
(iii) Quality improvement: [To find & remedy the basic causes]

- It aims to attain levels of performance that are significantly higher than current levels.

- 8 steps to quality improvement.

- ✓ Build awareness of the need & opportunity for improvement.
- ✓ Set goals for improvement.
- ✓ Organise to reach the goals.
- ✓ provide training.
- ✓ Carry out projects to solve problems.
- ✓ Report progress.
- ✓ Give recognition.
- ✓ Communicate results.
- ✓ keep score.
- ✓ Maintain momentum by making annual improvement part of the regular systems & processes of the company.

Diagram: (Designed to reduce the cost of quality over time.)



209 2.10 CROSBY'S 14-STEPS FOR QUALITY IMPROVEMENT!

(i) Management Commitment:

- Management is committed to quality & this is clear to all.

(ii) Formulate the Quality Improvement Team.

- Create quality improvement teams with representatives from all workgroups & functions.

(iii) Measure for quality in current practices.

- Measure processes to determine current & potential quality issues.

(iv) Cost of quality evaluation:

- Calculate the cost of poor quality.

(v) Quality awareness is central to success.

- Raise quality awareness of all employees.

(vi) Quality Problems?

Take corrective actions.

- Provide a systematic method of permanently resolving the problems that are identified through previous action steps.

- Problems that are identified during the acceptance operation must be documented & then resolved formally.

(vii) Plan for zero defects:

- Define all the individual action steps that build-up to zero defects day.

- These steps, placed on a schedule & assigned to members of the zero defects team for execution, will provide a clean energy flow into an organization-wide zero defects

Commitment.

(viii) Practice effective training for supervisors. (a) Employee Education:

- Define supervisor's training needs.

- Establish effective communication systems for planning & laying

out quality improvement programs.

- Make sure everybody understood & can implement the program.

(ix) Hold zero defects day:

- Zero defects is a revelation to all involved that they are embarking on a new way of corporate life.
- Working under this discipline requires personal commitments & understanding.

(x) Involve everyone in Goal setting:

- Encourage employees to create their own quality improvement goals.

(xi) Eliminate causes of errors:

- Eliminate barriers to enable the staff to communicate problems to Management.
- Error-cause removal (ECR) is set up on the basis that the worker need only recognize the problem.

- When the worker has stated the problem, the proper department in the plant can look into it.

(xii) Implement Recognition for participants.

(xiii) Create quality councils.

(xiv) Do it all over again - quality improvement does not end.

DIMENSIONS OF PRODUCT & SERVICE QUALITY:

[DATE: ...]

[11.9.11] NOV/DEC-2016

a) DIMENSIONS OF PRODUCT QUALITY:

(i) Performance:

- How well the product performs in comparison to how it was designed to perform.

(ii) Reliability:

- Likelihood that the product will perform throughout its expected life.

(iii) Durability:

- The actual life expectancy of the product.

(iv) Conformance:

- Does the product meet its specifications as designed.

(v) Features:

- What different functions (or) tasks can the product perform.

(vi) Aesthetics:

- Is the styling, color, workmanship pleasing to the customer.

(vii) Serviceability:

- What is the ease of fixing (or) repairing the product if it fails.

(viii) Perceived Quality:

- Based on customer's experience before, during & after they purchase a product.

b) DIMENSIONS OF SERVICE QUALITY:

✓ Customer service is the set of activities an organization uses to win & retain customer's satisfaction.

✓ It can be provided before, during (or) after the sale of the product (or) exist on its own.

✓ Elements:

(i) Organization:

→ Identify each market segment.

→ Write down the requirements.

- Communicate the requirements.
- Organize processes.
- Organize physical spaces.

(ii) Customer Care:

- Meet the customer's expectations.
- Get the customer's point of view.
- Deliver what is promised.
- Make the customer feel valued.
- Respond to all complaints.
- Over-respond to the customer.
- Provide a clean & comfortable customer/reception area.

(iii) Communication:

- Optimize the trade-off b/w time & personal attention.
- Minimize the number of contact points.
- Provide pleasant, knowledgeable & enthusiastic employees (lively).
- Write document in customer friendly language.

(iv) Front-line people:

- Hire people who like people.
- Challenge them to develop better methods.
- Give them the authority to solve problems.
- Serve them as internal customers.
- Be sure they are adequately trained.
- Recognize & reward performance.

(v) Leadership:

- Lead by example.
- Listen to the front-line people.

QUALITY STATEMENTS:

• Quality statements are part of strategic planning & once developed are occasionally reviewed & updated.

• Types:

(i) Vision statements:

- It describes how the future will look if the organization achieves its mission.

(ii) Mission statements:

- It provides clear statement of purpose for employees, customers & suppliers.

(iii) Quality policy statement:

- The quality policy is a guide for everyone in the organization as to how they should provide products & services to the customers.

• The utilization of these statements varies from organization to organization.

• Small organization may use only the quality policy statement.

• Business strategies that tend to reflect a customer orientation might include:

(a) Developing a quality product appreciated by customers;

(b) Responding promptly & respectfully to customer complaints;

(c) Seeking continuously with communication.

(i) Before the target market carefully & collect the most information.

(ii) Find out customer's needs & wants.

(iii) Find out customer's needs & wants.

CUSTOMER FOCUS:

- The orientation of an organisation toward serving its clients' needs.
- Having a customer focus is usually a strong contributor to the overall success of a business & involves ensuring that all aspects of the company put its customers' satisfaction first.
- Also, having a customer focus usually includes -
 - maintaining an effective customer relations & service program.
 - supplier partnership.
 - service relationship with internal customers.
 - Never compromise quality.
 - Customer driven standards.

CUSTOMER ORIENTATION:

- A group of actions taken by a business to support its sales & service staff in considering client needs & satisfaction their major priorities.
- Business strategies that tend to reflect a customer orientation might include:
 - a) Developing a quality product appreciated by customers;
 - b) responding promptly & respectfully to consumer complaints & queries; &
 - c) dealing continuously with communication.
- Consumer orientation calls for following actions:
 - i) Define the target market carefully & collect relevant information.
 - ii) Find out customer's needs & wants.

- (iii) Produce products as per their expectations.
- (iv) Ensure fair deal with customers & ensure commitment toward them.
- (v) Establish & maintain long-term relations with consumers.
- (vi) Provide them correct information when demanded.
- (vii) Safeguard their long-term interest / welfare.
- (viii) Treat them as business partners.
- (ix) Take care of consumers suggestions & tackle their complaints.
- (x) Find out the best way to entertain them, & meet their expectations.

CUSTOMER SATISFACTION:

[NOV/DEC-2016]

[MAY/JUNE-2018]

✓ Quality is a measure of customer satisfaction.

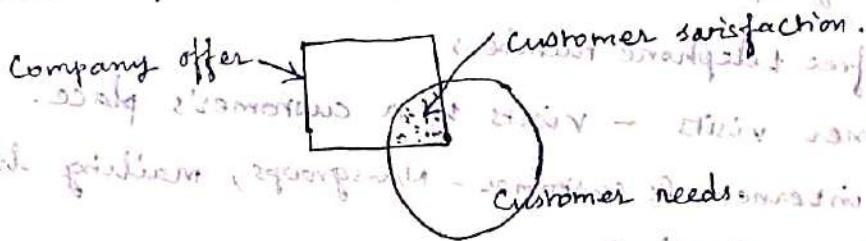
It is obvious that business can't survive satisfied customers.

Therefore TQM's purpose is meeting (or) exceeding customer expectations so that the customers are delighted.

✓ It is understood that the customer satisfaction must be the primary goal of any organization.

Therefore it is essential that every employee in the organisation understands the importance of the customer.

• Customer satisfaction Model: (or Teboul's Model).



• Customer:

- most important people in the business - part of business, not outsiders.

- people who come with their needs & jobs.

(i) Internal customers:

- The customers inside the company are called internal customer.

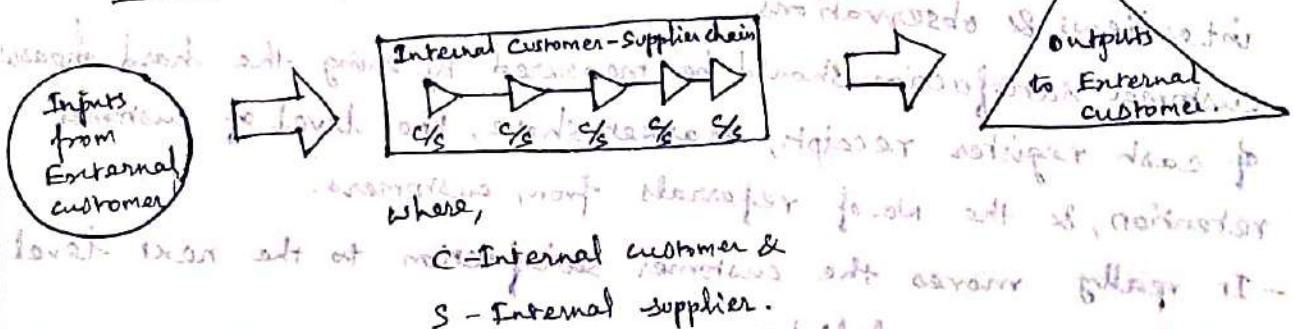
- Every person in a process is considered as a customer of the preceding operation.

(ii) External customers:

- The customers outside the company are called external customer.

- who uses the product (or) service - who purchases the product (or) service.

• Customer - supplier chain:



CUSTOMER COMPLAINTS (or) CUSTOMER FEEDBACK. [APRIL/MAY-2025]

COSTS

DE

Requirements:

- to discover customer dissatisfaction - to identify customer's needs.
- to discover relative priorities of quality - to compare performance with the competition - &
- to determine opportunities, for improvement.

Tools used for collecting customer complaints are:

- (i) comment card - It issued with the product at the time of sales.
- (ii) customer questionnaire - Surveys through E-mail & telephone.
- (iii) Focus groups - customer meetings, discussions, relaxation techniques, etc.
- (iv) Toll-free telephone numbers.
- (v) Customer visits - visits to a customer's place.
- (vi) The internet & customer - Newsgroups, mailing lists, etc.
- (vii) Employee feedback.
- (viii) Report cards.

CUSTOMER RETENTION:

DEFINITION: It is the process of retaining the existing customers.

It is obvious that customer retention is more powerful & effective than customer satisfaction.

- It represents the activities that produce the necessary customer satisfaction that creates customer loyalty.

- It can be improved by obtaining customer feedback & by measuring customer satisfaction.

- It is obtained from customer satisfaction surveys, focus groups, interviews & observations.

- Customer satisfaction should be measured by using the hard measures of cash register receipts, market share, the level of customer retention, & the No. of referrals from customers.

- It really moves the customer satisfaction to the next level called customer delight.

COSTS OF QUALITY:

[APRIL-2014]

DEFINITION: It is defined as those costs associated with the non-achievement of product / service quality as defined by the requirements established by the organisation & its contracts with customers & society.

ELEMENTS:

(i) Prevention cost:

✓ - Costs that are incurred on preventing a quality problem from arising.

- It relates to efforts to prevent failures.

✓ → It includes,

- Cost of quality planning - documenting - process control cost - Training - preventing recurring defects - Investigation, analysis & correction of causes of defects by quality control - quality awareness programme.

(ii) Appraisal cost:

✓ - The costs that incurred in assessing that the products/services conform to the requirements.

- It relates to testing, execution & examination to assess whether specified quality is being maintained.

✓ → It includes,

- Test & inspection - laboratory acceptance testing - Installation testing - Installation & commissioning - Maintenance & calibration of testing & inspecting equipments - Depreciation + Analysis of reporting of tests & inspection results - Line quality engineering - Vendor rejects.

(iii) Internal failure cost:

- Due to internal failures. (it occurs)

- These costs are linked to correcting mistakes before delivery of the product, such as [scrap, rejects, adjustments,

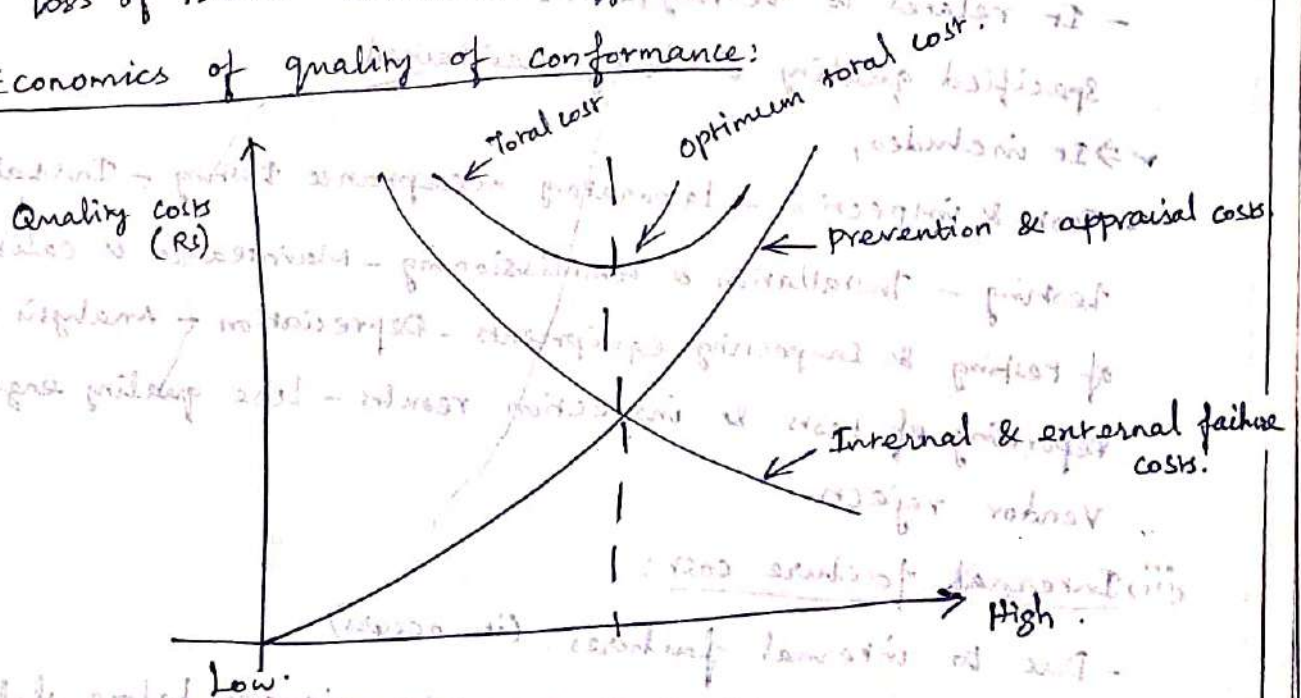
downtime of equipment, labour sitting idle while waiting for repairs, & sales discounts for inferior products.

- ✓ It includes,
 - cost associated with scrap & rejects - repair & rework - design changes
 - trouble-shooting (or) defect failure analysis - reinspection & retesting
 - Sales discounts for inferior products - downgrading - downtime.

(iv) External failure costs:

- It arises from the rejection of the products / services by the customers due to poor quality.
- These costs are associated with the adjustments of malfunctions after delivery of the product, such as: [repair costs, travel & lodging expenses, replacement costs, stock spare parts, loss goodwill of customer, guarantee & warranty costs & dispatchment costs.
- It includes,
 - processing complaints from customers - Commissioning failures - Servicing (or) replacing the defective items - guarantee & warranty claims - good will of customer - product reliability compensation - loss of sales - concessions offered to customer.

• Economics of quality of conformance:



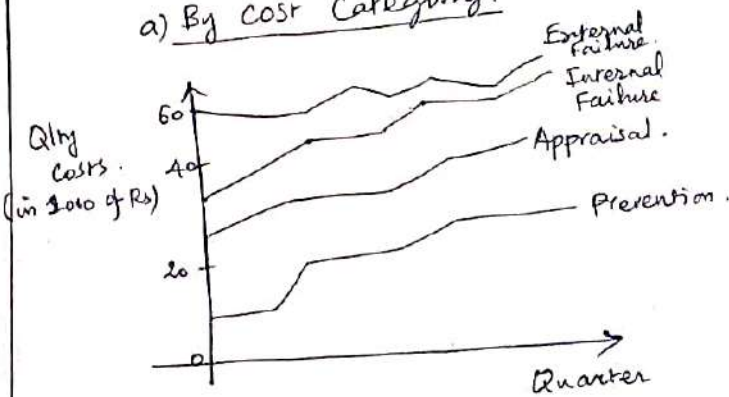
ANALYSIS TECHNIQUES FOR QUALITY COSTS:

- For analysing the quality costs are trend & pareto Analysis.
- To determine opportunities for quality improvement.

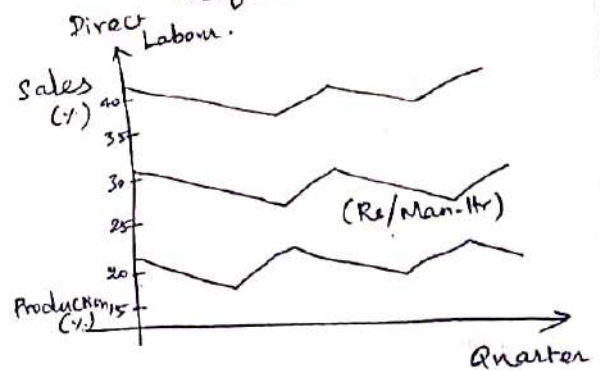
(i) TREND ANALYSIS (OR) TREND GRAPHS:

- It is a planning tool that provides information for long-range planning.
- It also provides information for the investigation & Assessment of quality improvement programmes.
- It can be established by Cost Category, by sub-category, by product, by measurement, by department, by machine & by combinations thereof.
- * The purpose of Analysis, time scales for these trend graph may be by month, quarter (or) year.
- Typical Trend Graphs:

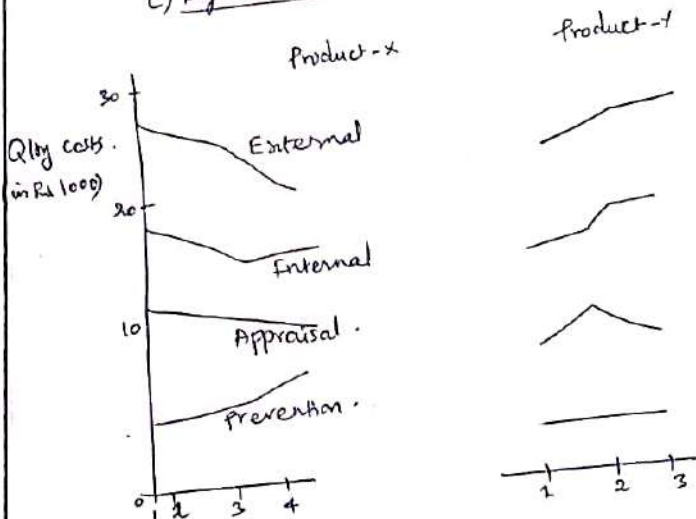
a) By Cost Category:



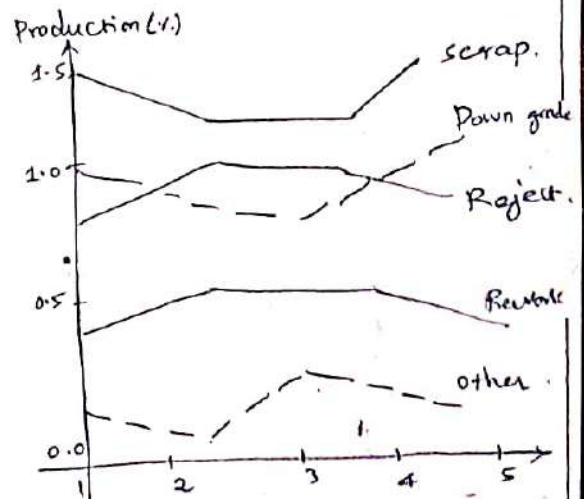
b) By Index:



c) By Product:



d) within a Category:



(ii) PARETO ANALYSIS:

DEFINITION:

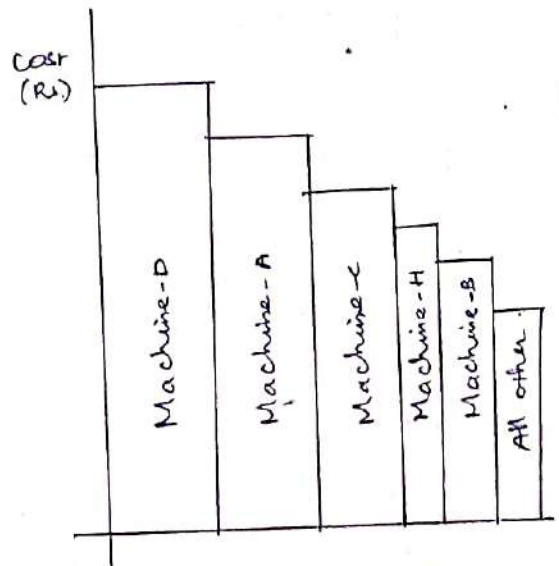
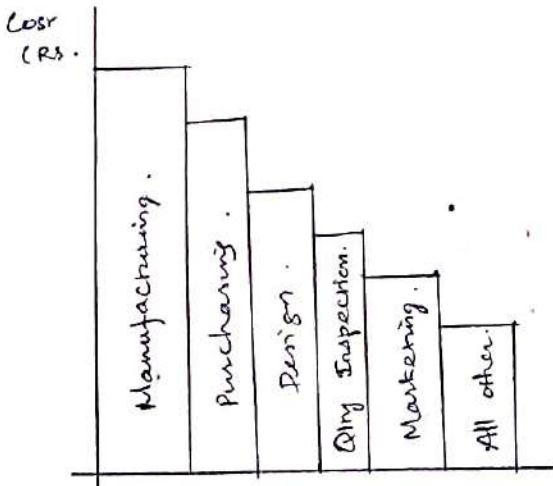
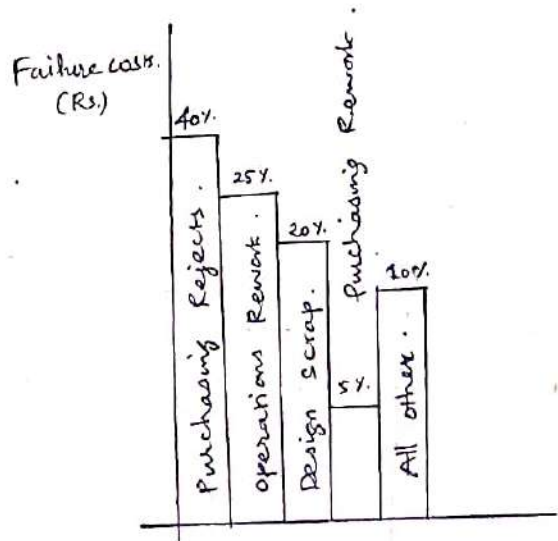
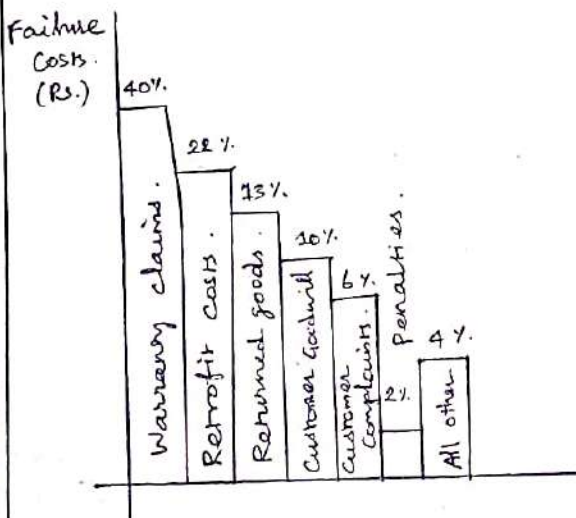
It is a method of classifying items, events (or) activities according to their relative importance.

→ It's principle, which states that a few of the defects accounts for most of the effects.

→ It can be established for quality costs by operator, by machine, by product line, by non-conforming, by category, by element and so forth.

TYPICAL PARETO DIAGRAMS AND THEIR INTERPRETATIONS:

a) For External Failures:



LEADERSHIP:

• It is the process of influencing others towards the accomplishment of goals.

CHARACTERISTICS (OR) BEHAVIOUR OF QUALITY LEADERS:

- (i) The customer first → Leaders should listen to customers.
→ Lead the handling of complaints.
- (ii) Value People → They monitor appraise & Recognize people's performance.
- (iii) Build supplier Partnership → They recognize Quality improvements made by suppliers & encourage joint improvement action.
- (iv) Empower People → Train and Coach the people.
- (v) Demonstrate involvement / commitment → To the Quality.
- (vi) Strive for Excellence → There is always room for improvement.
- (vii) Explain & Deploy policy → They set stretching Targets.
- (viii) Improve Communication → They establish channels of communication which are reliable & accessible to everyone in the organization.
- (ix) Promote Team work → Create involvement & Active participation of Everyone.
- (x) Benchmark continuously → create New learning effects through innovation.
- (xi) Establish system → To support the Quality effort.
- (xii) Encourage collaboration → Among & within Functional Areas, Departments & work centres.

UNIT - III

TQM TOOLS AND TECHNIQUES - I

TRADITIONAL MANAGEMENT TOOLS: (SEVEN TYPES)

(i) CHECK SHEETS:

• A systematic data gathering & registering to get a clear view of the facts.

• Types:

a) Process distribution.

b) Defective.

c) Defect location.

d) Defect factor.

• Ex:

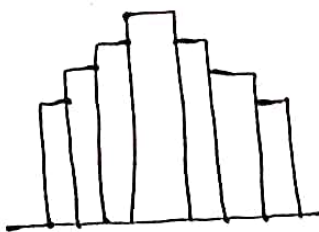
S.No.	PROBLEMS.					FREQUENCY
1.	Delivery	III	II			7
2.	Packaging.	II				2
3.	Qty/Performance.	IIII	III	I		11
4.	Personnel	III	III			10
5.	Invoicing.	III	III	III	III	18

(ii) HISTOGRAMS (or) BAR GRAPHS:

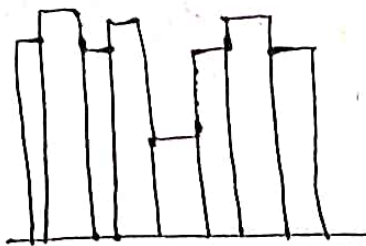
• It is showing distribution of variable quantities (or) characteristics.

• Types:

a) Bell-shaped.



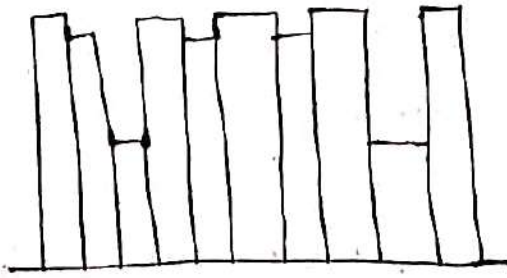
b) Double-peaked.



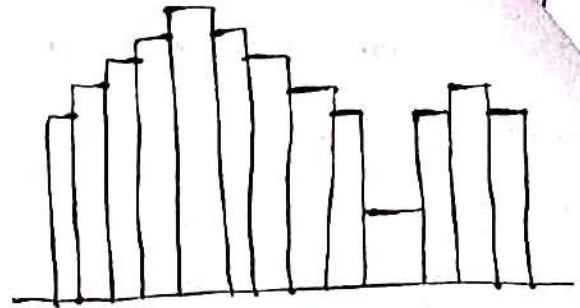
c) Plateau.



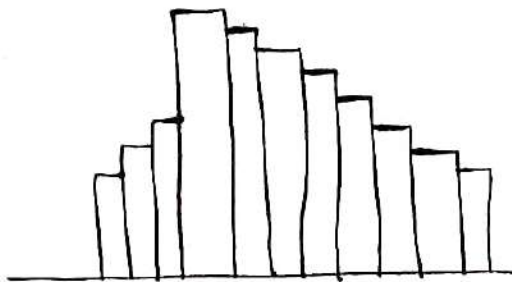
d) Comb:



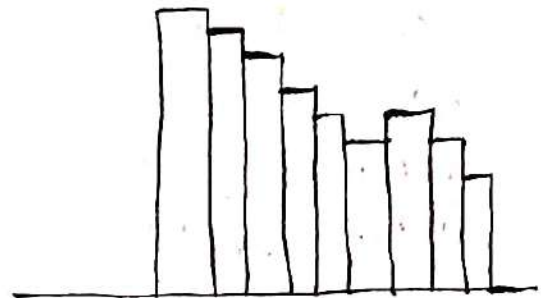
e) Isolated Peak:



f) Skewed:

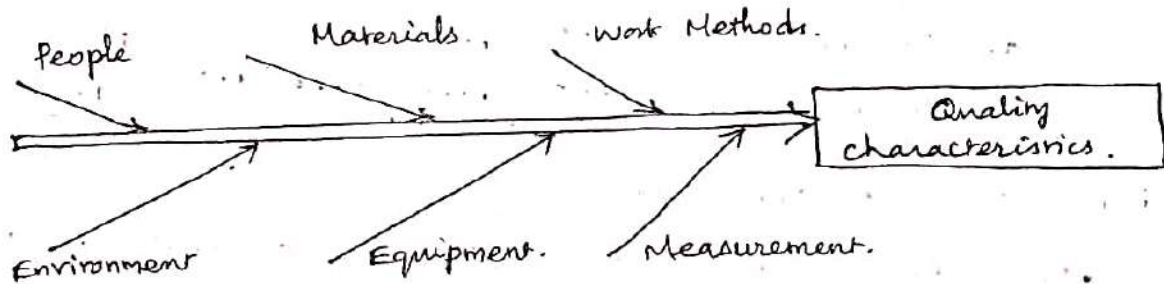


g) Truncated:



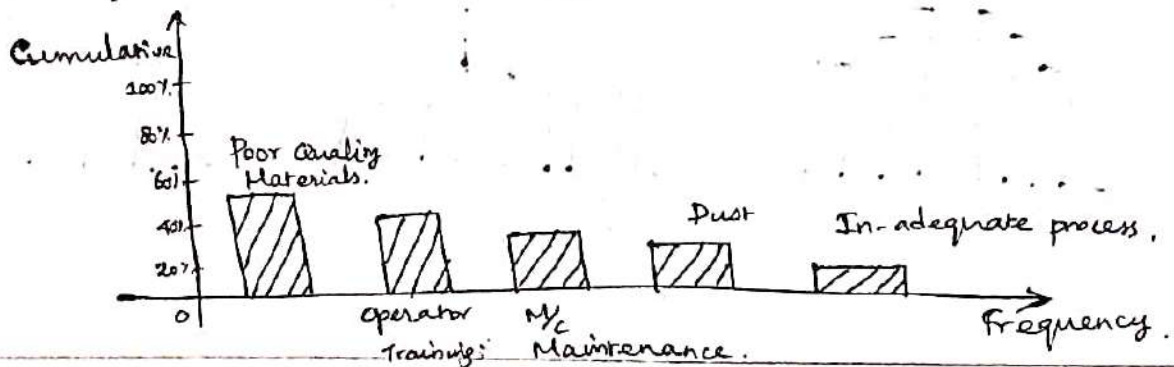
(ii) CAUSE & EFFECT DIAGRAM: (FISH BONE (or) ISHIKAWA DIAGRAM).

• It is a graphical chart to list and analyse the potential causes of a given problem.



(iv) BAR GRAPH:

• The length of the bars represent frequency (or) costs are arranged with longest bars on the left & shortest to the right.



(V) PROCESS FLOW DIAGRAM:

• It is representation showing all steps and process involve in the operation.

• It reduces the cyclic time.

• Steps:

Determine the Method of classifying Data.



Decide if money & Frequency - It is used to rank the characteristics.



Collect Data for an appropriate time interval (or) use Historical Data.



Summarise the Data & Rank order categories from largest to smallest.



Construct the diagram & Find vital Few.

(VI) CONTROL CHARTS:

• It displays data taken over time & variations of this data.

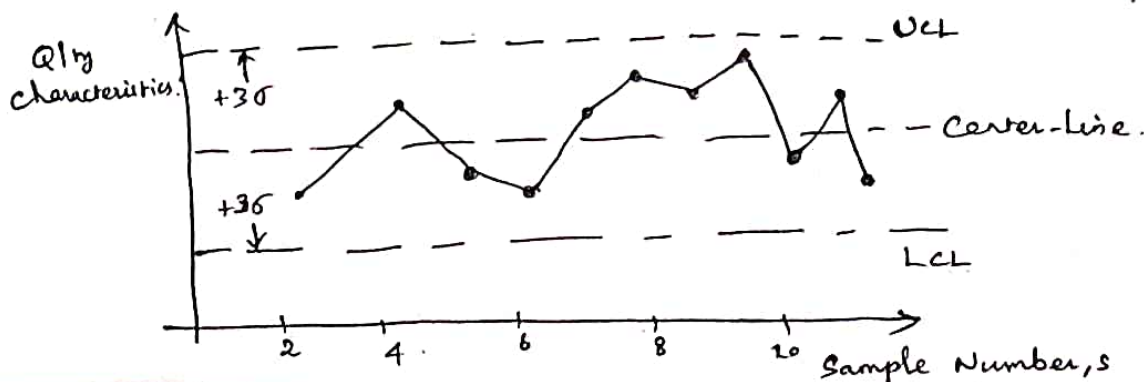
• It illustrates the dynamic performance.

• It is based on a series of random samples taken at regular intervals.

• Types:

(a) Control chart for variables.

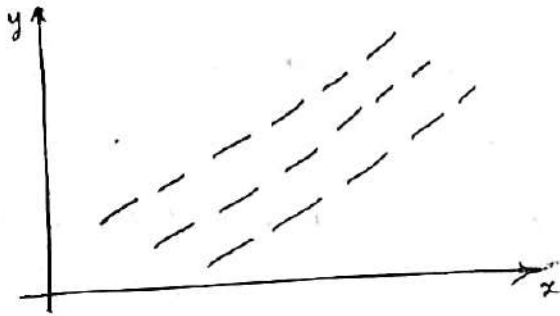
(b) Control chart for characteristics.



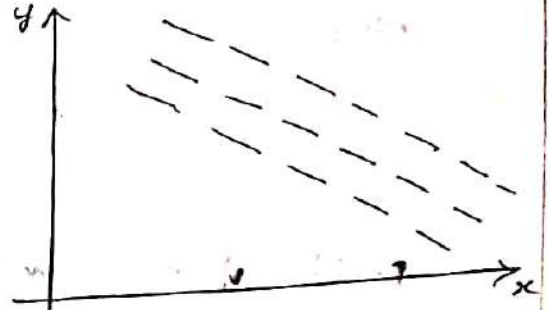
(ii) SCATTER DIAGRAM:

• It is the simplest way to determine the cause & Effect relationship b/w two variables.

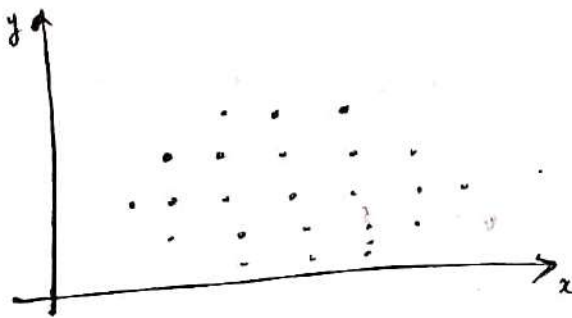
a) Positive Correlation:



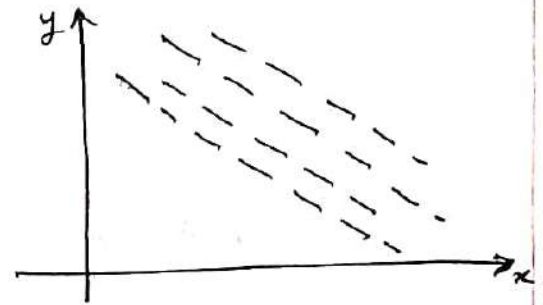
b) Negative Correlation:



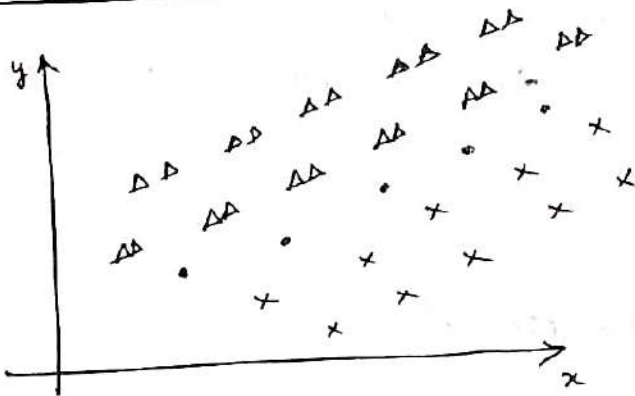
c) No correlation.



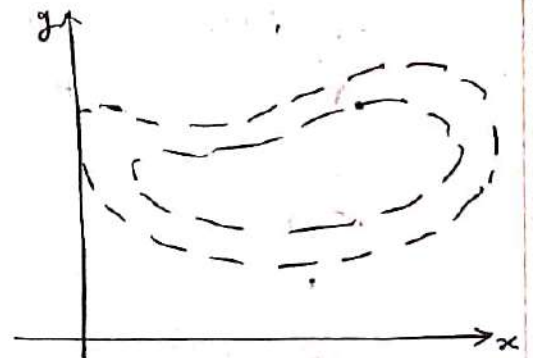
d) Negative may exist.



e) Correlation by stratification:



f) Curvilinear Relationship.



NEW SEVEN MANAGEMENT TOOLS:

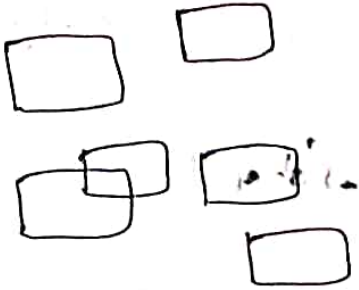
(i) AFFINITY DIAGRAM:

• It is for synthesizing, classifying, organizing indefinite ideas.

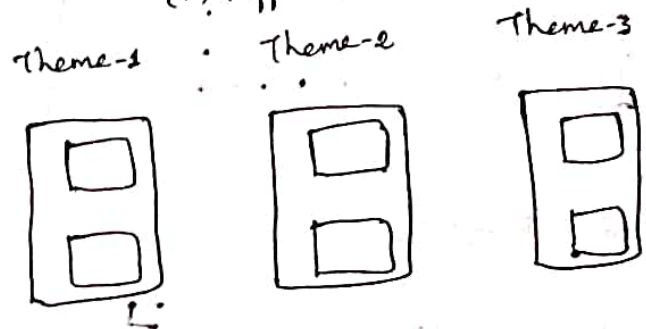
Steps:

- Record each idea on cards (or) notes.
- Look for ideas that seem to be related.
- Sort cards into groups until all cards have been used.

(*) Un-organized ideas:

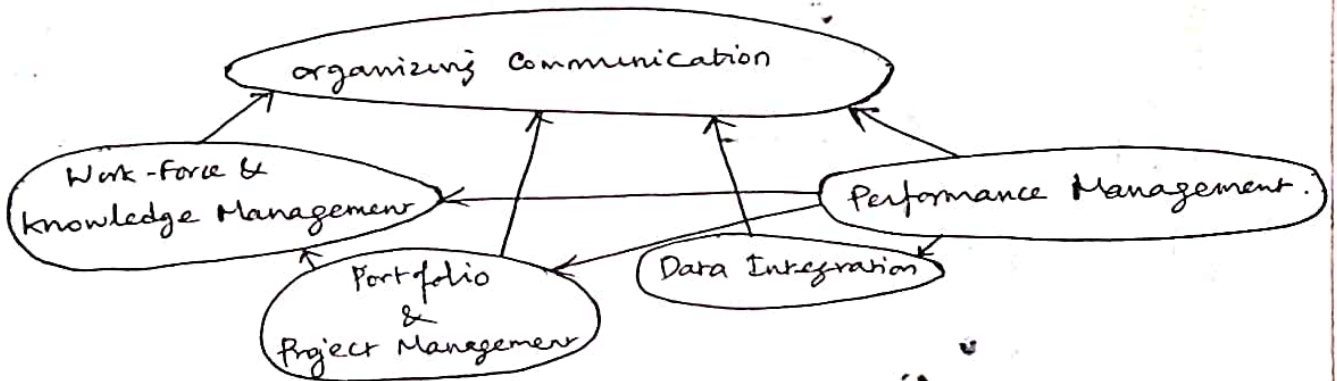


(*) Affinity:



(ii) RELATIONSHIP DIAGRAM: (or) INTER-RELATIONSHIP DIAGRAM:

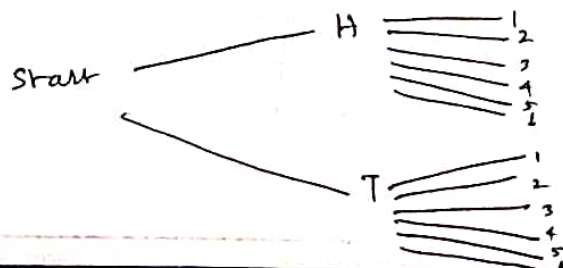
• It is tool for finding causes to a problem.



(iii) TREE DIAGRAM:

• It starts with one item that branches into two (or) more, each of which branch into two (or) more & so on.

• It looks like a tree, with a trunk & multiple branches.

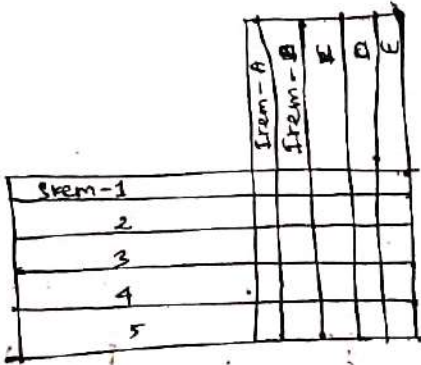


MATRIX DIAGRAM:

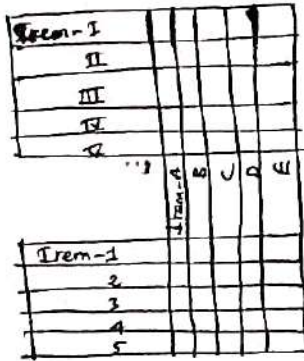
• It is relationship between 2, 3 (or) 4 groups of information.

• Types:

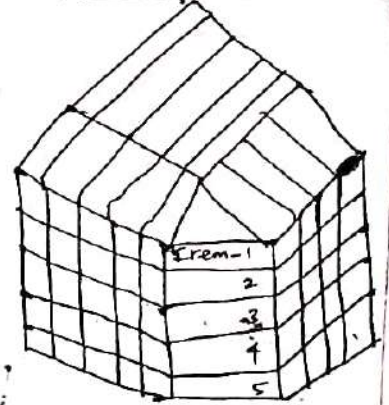
a) L-shaped:



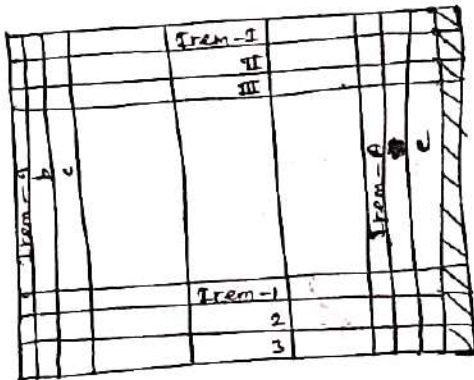
b) T-shaped:



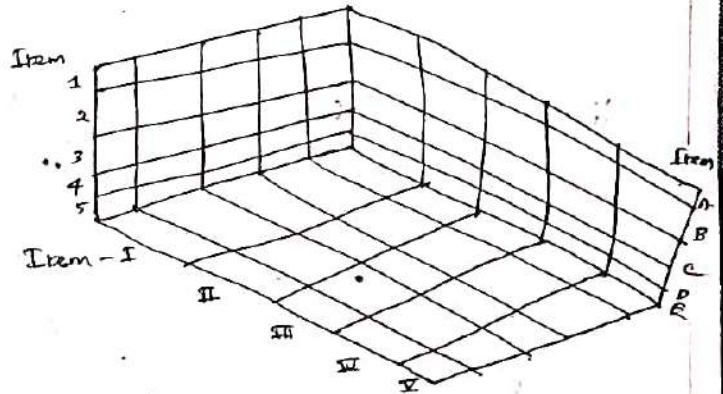
c) Y-shaped:



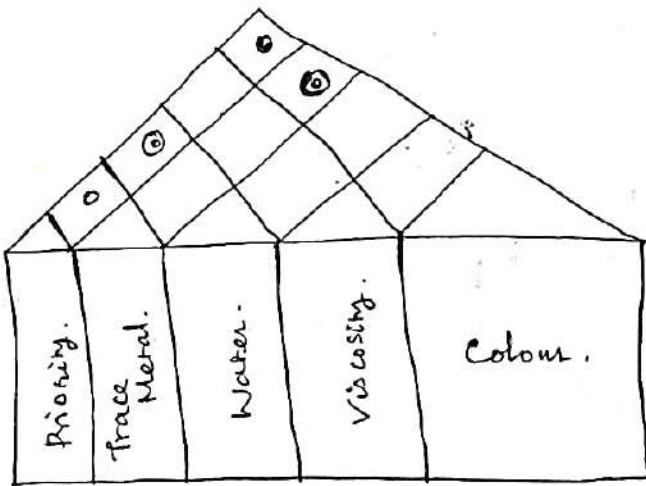
d) X-shaped:



e) cube shaped:

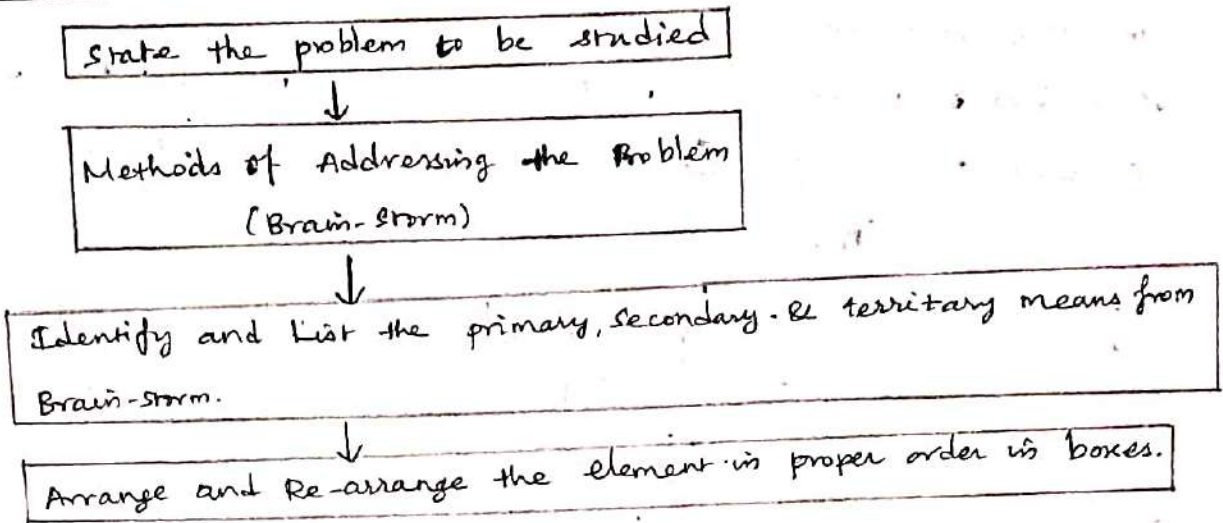


f) Roof-shaped:



NOTE:

• TREE DIAGRAM - STEPS:



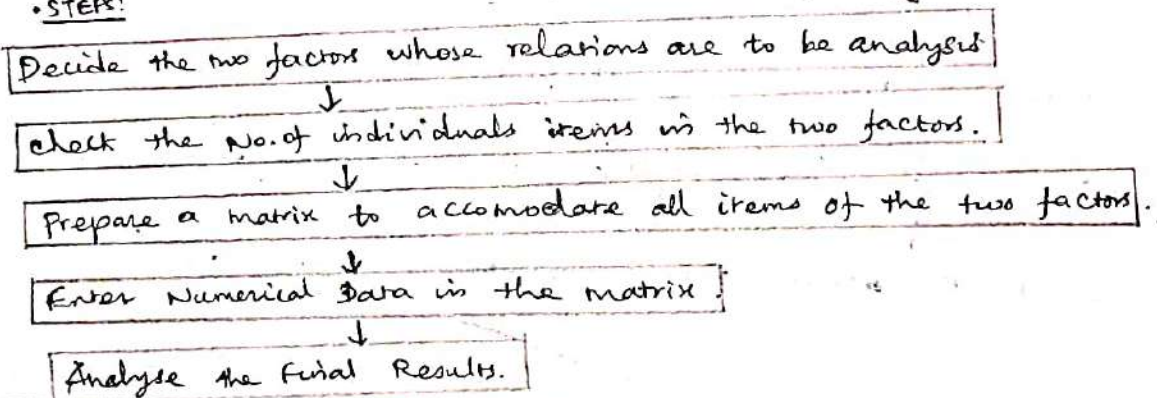
(V) MATRIX DATA ANALYSIS DIAGRAM (or) PRIORITIZATION MATRICES:

- It evaluates and priorities a list of options.
- It is very much similar to a matrix diagram with a difference that numerical data is used instead of symbols indicating the existence and strength of relationship.

Objective \ Action	Improved Knowledge Training	Improved Kitchen Process	Improved Delivery Process	Improved Controls
30 Min's Max. Wait	⊙	⊙	⊙	⊙
Friendly Drives	⊙	⊙	⊙	⊙
Continuous order Taken	⊙	⊙	⊙	⊙

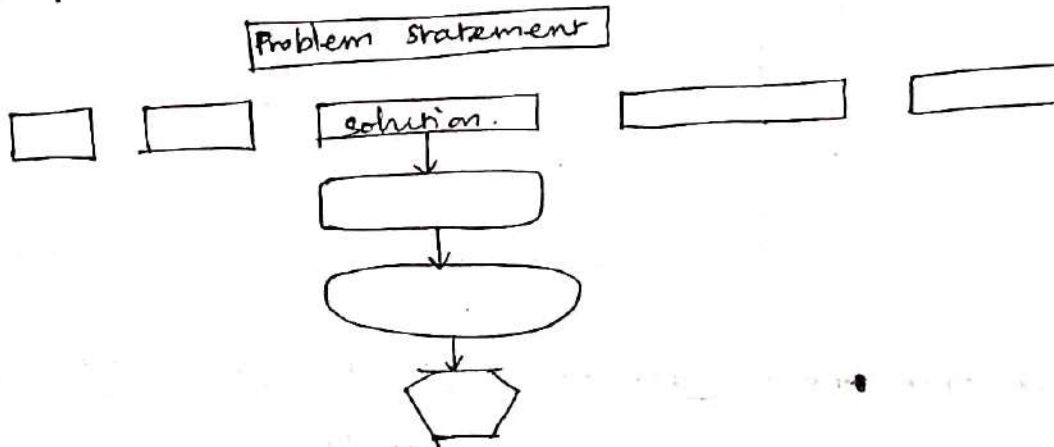
Strong Relationship Weak Relationship Moderate Relationship

• STEPS:



(vi) PROCESS DECISION PROGRAM CHART (PDPC) OR DECISION TREE:

- It is planning tool to outline every conceivable & likely occurrence in any planning.
- This tool is widely used in decision making when the task is new, complex and unique. [New Development, Building - Equipment & Processing Programs.]



(vii) ACTIVITY NETWORK DIAGRAM OR ARROW DIAGRAM:

- It is a graphic description of the sequential steps that must be completed before a project can be completed.

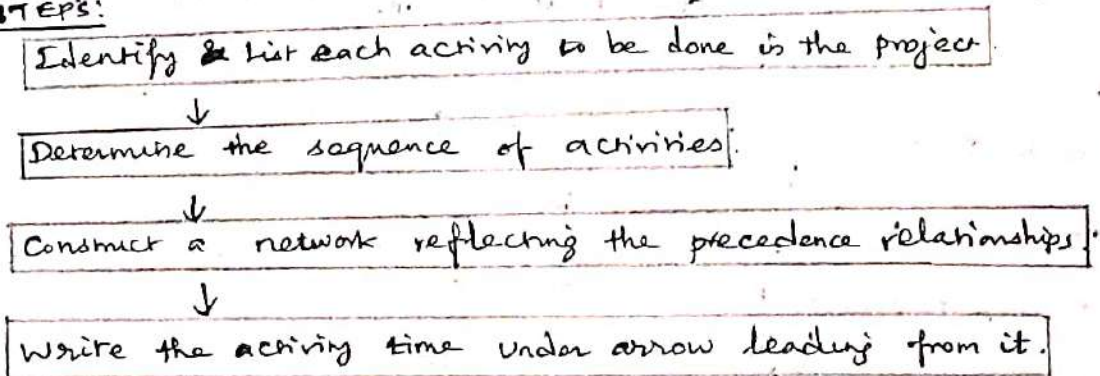
PURPOSES:

- To show the paths to complete a project.
- To find the shortest time possible for the project and
- To display graphically simultaneous activities.

Ex: PERT, CPM.

- It determines the critical path of a process (or) a project.

STEPS:



CONCEPT:





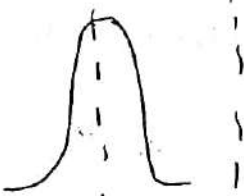
• Before studying the concept of six-sigma, 1st let us re-introduce the concept of process capability ratio (Cp).

$$C_p = \frac{\text{Design Width}}{\text{Process Width}} = \frac{USL - LSL}{UCL - LCL}$$

where,

USL - Upper specification limit / LSL - Lower

UCL - Upper Control Limit / LCL - Lower

PROCESS CAPABILITY	C _p	TOTAL AMOUNT OUTSIDE LIMITS	TYPICAL ACTIONS TO BE TAKEN.
	0.67	4.56% (45,500 ppm)	<ul style="list-style-type: none"> • Heavy process control, • Sorting Rework, etc.
	1.0	2700 ppm	<ul style="list-style-type: none"> • Heavy process control, • Inspection.
	1.33	64 ppm	<ul style="list-style-type: none"> • Reduced inspection, • selected use of control charts.
	1.67	1 ppm	<ul style="list-style-type: none"> • spot checking, • selected use of control charts.
	2	0.001 ppm	<ul style="list-style-type: none"> • Reduced need for control. • Uniforming in process inputs.

CONCEPTS OF SIX-SIGMA:

- It stands for six standard deviation from mean.
- It uses to improve the capability & reduce the defects in any process.
- OBJECTIVE: To achieve zero defects product / process.
- SCOPE:
 - Concept is originated from manufacturing field,
 - Now it is applied to non-manufacturing processes.
 - Other fields such as, [Services, Medical, Insurance Procedures & Call centres, etc.]
- STEPS: [APPLICATION OF SIX-SIGMA → MOTOROLA]

CONCEPTS	FUNCTIONS.
Identify the Process	→ Create (or) Service.
Identify the customers.	→ Product (or) Service & Der. what they Consider important.
Identify the needs.	→ Product (or) Service satisfy the customer.
Define the process	→ Doing work.
Mistake proof the process	→ Eliminate waste effort.
Continuous Improvement	→ Improve the measuring, Analysing and controlling the process.

PROCESS (or) PHASES (or) METHODOLOGY:

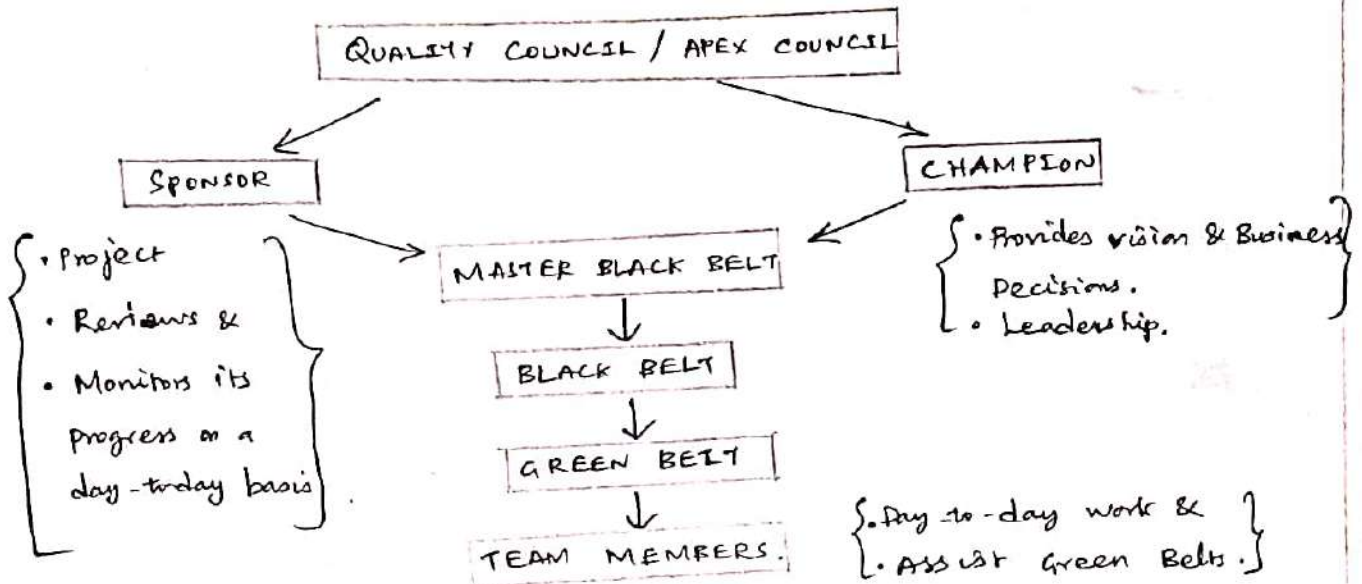
I. DEFINE

- Determine the benchmarks.
- Set the base-line.
- Der. Customer requirements.
- Get customer commitment.
- Map process flow.

ROLE OF 6σ IN SERVICE SECTORS (INCLUDING IT):

- The involvement & participation of all the employees as well as the top management of the organization are crucial.

• ORGANIZING STRUCTURE:



(i) Quality Council / Apex Council:

- Heads all the functions.
- It controls & periodically review the entire six-sigma activity, project identification, performance of the project teams & Effectiveness of the solution & their implementation.

(ii) Master Black Belt:

- Chief Engineer (or) Technical heads a key role in training & coaching.

(iii) BLACK Belt:

- Team leader who is trained & certified in 6σ methodology.

(iv) GREEN BELT:

- This project head (or) process owners, they are execute 6σ projects as part of their normal job.

ARROW DIAGRAM:

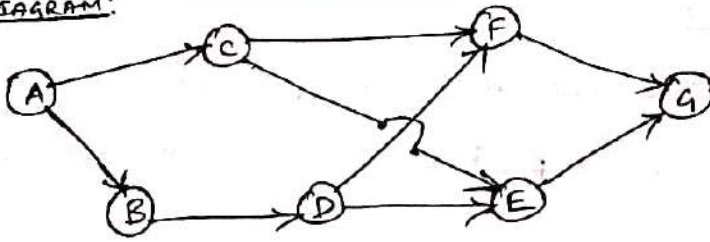


TABLE:

Activity	Designation	Immediate predecessors	Time in weeks
Design	A	-	16
Build Proto-type	B	A	6
Evaluate Equipment	C	A	7
Test Proto-type	D	B	3
Write Eq. Report	E	C, D	4
Write Methods Report	F	C, D	7
Write Final Report	G	E, F	2

II. Me

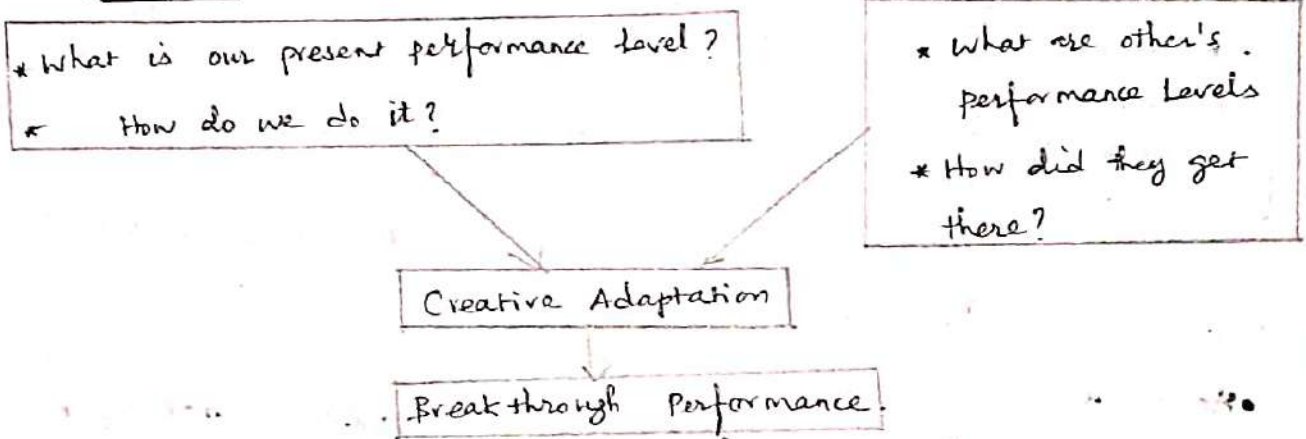
BENCH MARKING:

DEFINITION:

• The process of identifying, understanding & adapting outstanding practices & processes from organizations anywhere in the world to an organization to improve its performance.

• The systematic comparison of elements of performance of an organization against those of other organizations, usually with the aim of mutual improvement.

DIAGRAM:



Reasons to Bench-mark (or) OBJECTIVES:

- It aims at a goal setting process to facilitate comparison with the best.
- It aims at motivating & stimulating company employees towards the goal of continuous quality improvement.
- It aims at external orientation of the company.
- It aims at identifying a technological breakthrough.
- It aims at searching for industry best practices.

TYPES:

a) Based on object.

- (i) Product
- (ii) Performance
- (iii) Process
- (iv) Strategic

b) Based on organization.

- (i) Internal
- (ii) Industry
- (iii) Competitive
- (iv) Best-in-class &
- (v) Relationship

II. MEASURE

- Develop Defect measurement.
- Develop Data Collection Process.
- Collect Data.
- Create forms.
- Compile and Display the Data.

III. ANALYSE

- Verify the Data.
- Draw conclusions from Data.
- Test conclusions.
- Det. improvement opportunities.
- Det. root causes.
- Map Causes to effects.

IV. IMPROVE

- Create improvement ideas.
- Create models.
- Experiment.
- Set goals.
- Create problem & solution statement.
- Implement improvement methods.

V. CONTROL

- Monitor improvement progress.
- Measure improvement statistically.
- Assess effectiveness.
- Make needed adjustments.

• PROCESS:

PHASES	STEPS
PLANNING	<p>To identify,</p> <ul style="list-style-type: none"> → What is to be benchmarked? (Formulate the project goals) → Identifying benchmark partners. → Det. data collection method & collect data.
ANALYSIS	<ul style="list-style-type: none"> → It involves a careful understanding of current process practices as well as those of benchmarking partners. → Det. the current performance gap. → Project future performance levels.
INTEGRATION	<ul style="list-style-type: none"> → It involves careful planning to incorporate new practices in the operation & ensures that benchmarking findings are incorporated in all formal planning process. → Establish functional goals. <ul style="list-style-type: none"> (i) Communicate data for analysis. (ii) Give acceptance for analysis. → Communicate benchmark findings & gain acceptance.
ACTION.	<ul style="list-style-type: none"> (i) Develop action plans. (ii) Implement specific actions & monitor the progress. (iii) Recalibrate benchmarks.
MATURITY	<ul style="list-style-type: none"> ⇒ It would be reached when best industry practices are incorporated in all business processes. → Attain the leadership position. → Integrate practices into the process.

FMEA - FAILURE MODE EFFECT ANALYSIS (OR) RISK ANALYSIS:

DEFINITION:

It is a preventive measure to systematically display the causes, effects & possible actions regarding observed failures.

TYPES:

(i) System FMEA

(ii) Design FMEA

(iii) Process FMEA

(iv) Service FMEA.

(v) Equipment FMEA.

(vi) Maintenance FMEA.

(vii) Concept FMEA.

(viii) Environmental FMEA.

STAGES: (OR FMEA Procedure) (OR) (FMEA METHODOLOGY).

(*) Specifying possibilities:

(i) Functions.

(ii) Possible failure modes.

(iii) Root causes.

(iv) Effects.

(v) Detection/Prevention.

(*) Quantifying Risk:

(i) Probabilty of cause.

(ii) Severity of Effects.

(iii) Effectiveness of control to prevent cause.

(iv) Risk Prioring Number (RPN).

(*) Correcting High Risk Causes:

(i) Prioring work.

(ii) Detailing Action.

(iii) Assigning Action responsibility.

(iv) Check points on completion.

(*) Re-evaluation of Risk:

- Re-calculation of Risk prioring Number.

• TYPES OF FMEA:

(i) SYSTEM FMEA:

- Analyses, components,
- Sub-system &
- Main system in early stage of Design.

(ii) DESIGN FMEA:

- Analyses the products,
- Parts before they are released to Manufacturing.

(iii) PROCESS FMEA:

- Focuses on Manufacturing & Assembly process.

(iv) SERVICE FMEA:

- Analyses service industry processes before they are released to impact the customer.

(v) Equipment FMEA.

(vi) Maintenance FMEA.

(vii) Concept FMEA.

(viii) Environmental FMEA.

UNIT - IV

TQM TOOLS AND TECHNIQUES - II

CONTROL CHARTS:

DEFINITION:

It is a graph that displays data taken over time & the variations of this data.

NOTE:

→ With the help of a control chart, one can find-out the natural capability of a production process.

→ It is used to check whether the process is controlled statically (or) not.

TYPES:

(i) CONTROL CHARTS FOR VARIABLES:

It requires a measurement of the quality characteristics of interest.

(ii) CONTROL CHARTS FOR ATTRIBUTES:

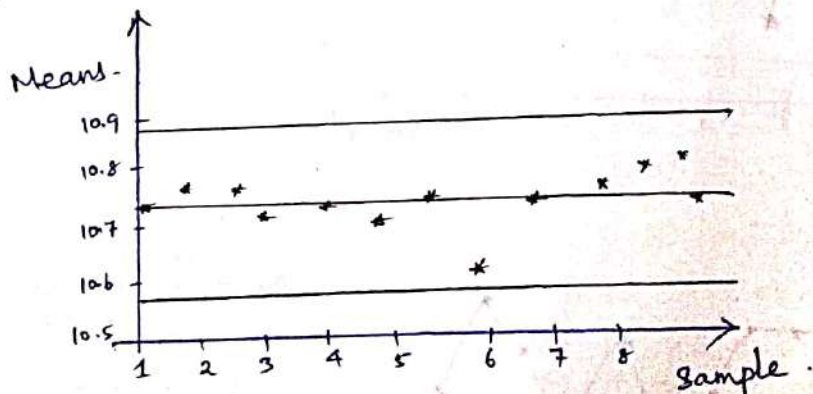
It requires a determination of whether a part is defective (or) how many defects are there in the sample.

(i) CONTROL CHARTS FOR VARIABLES:

The following types are,

a) \bar{X} (or) Average charts:

→ Monitor the centering of the process to control its accuracy.

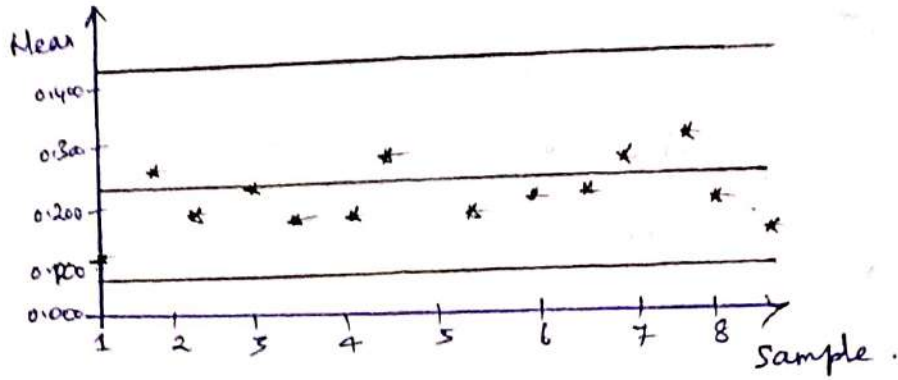


$$UCL = \bar{X} + A_2 \bar{R}$$

$$LCL = \bar{X} - A_2 \bar{R}$$

b) R-chart: (or) Range chart

→ Precision of the process.



$$UCL = D_4 \bar{R}$$

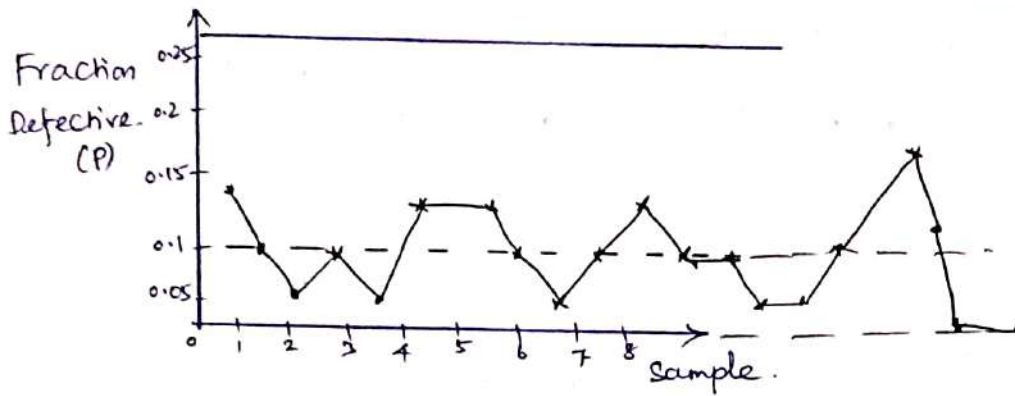
$$LCL = D_3 \bar{R}$$

(ii) CONTROL CHARTS FOR ATTRIBUTES:

• TYPES:

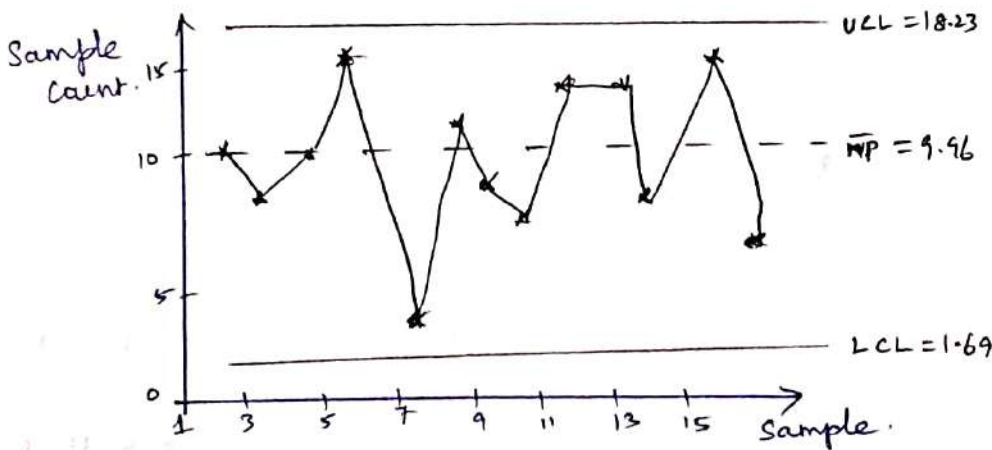
a) P-CHART:

$$CL = \bar{P} = \frac{\text{Defectives}}{\text{No. of Inspected}}$$

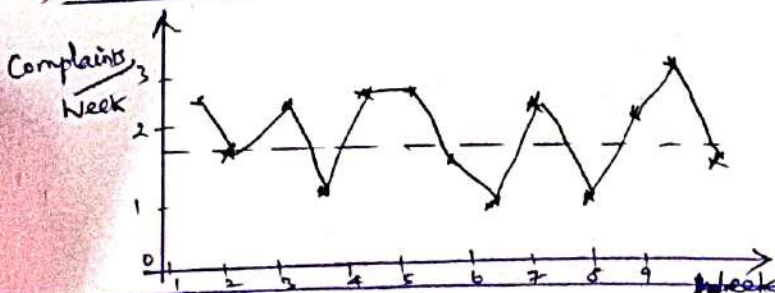


$$\sigma_p = \sqrt{\frac{\bar{P}(1-\bar{P})}{n}}$$

b) np-CHART:



c) C-CHART:



$$CL = \frac{\text{Complaints}}{\text{Samples}}$$

$$UCL = \bar{c} + z\sqrt{\bar{c}}$$

$$LCL = \bar{c} - z\sqrt{\bar{c}}$$

PROCESS CAPABILITY (= 6σ or natural tolerance)

DEFINITION:

It may be defined as the "minimum spread of a specific measurement variation which will include 99.7% of the measurements from the given process."

PURPOSE:

- (i) To find out whether the process is inherently capable of meeting the specified tolerance limits.
- (ii) To identify why a process 'capable' is failing to meet specifications.

PROCEDURE:

- (i) Calculate the avg. \bar{x} & range 'R' of each sample.
 - (ii) Calculate the grand avg. $\bar{\bar{x}}$.
- This measures the centering of the process.
- (iii) Calculate the control limits & plot \bar{x} & R-charts.
- These control charts measure the stability of the process.
- (iv) Calculate the process capability, $(6\sigma) = 6 \left(\frac{R}{d_2} \right)$.

d_2 - statistical factor (from table-5).

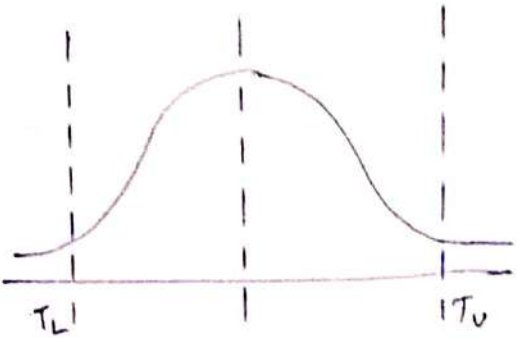
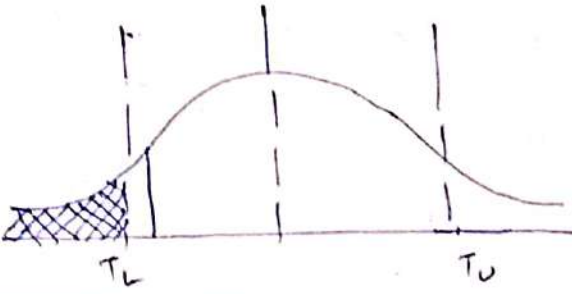
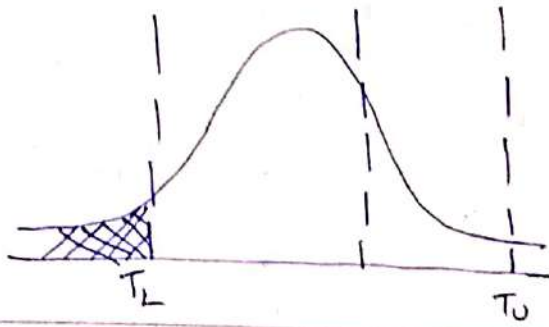
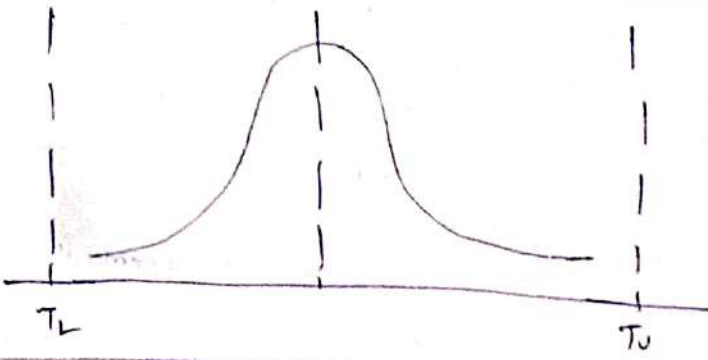
MEASURES: PROCESS CAPABILITY INDEX.

$C_p = (USL - LSL) / 6\sigma$		$C_{pk} = \min\{(USL - \bar{x}) / 3\sigma, (\bar{x} - LSL) / 3\sigma\}$	
$C_p > 1$	The process is capable of meeting the specifications	The process,	Confirms the specifications.
$C_p < 1$	The process, Not capable of meeting the specifications.	The process,	Not confirm to specifications.
$C_p = 1$	The process, is just meeting specification	The process,	just confirms to specifications.

It does not measure process
nominal (or) target value.

• If, $C_p = C_{pk}$,

then the process is centered.

$C_p = 1$	 <p>A normal distribution curve is shown on a horizontal axis. The lower specification limit is labeled T_L and the upper specification limit is labeled T_U. The curve is perfectly centered between these two limits, with a vertical dashed line at the mean.</p>	Process is "Capable."
$C_p < 1$	 <p>A normal distribution curve is shown on a horizontal axis. The lower specification limit is labeled T_L and the upper specification limit is labeled T_U. The curve is shifted to the right, so that T_U is closer to the mean than T_L. The area under the curve to the left of T_L is shaded with cross-hatching.</p>	Process is "Not capable"
$C_p = 1$ $C_{pk} < 1$	 <p>A normal distribution curve is shown on a horizontal axis. The lower specification limit is labeled T_L and the upper specification limit is labeled T_U. The curve is shifted to the right, so that T_U is closer to the mean than T_L. The area under the curve to the left of T_L is shaded with cross-hatching.</p>	Process is "Not capable"
$C_p > 1$	 <p>A normal distribution curve is shown on a horizontal axis. The lower specification limit is labeled T_L and the upper specification limit is labeled T_U. The curve is centered between these two limits, with a vertical dashed line at the mean.</p>	Process is "Very capable"

QUALITY FUNCTION DEVELOPMENT (QFD):

[14. a. APRIL | MAY-2015]

Nov/DEC-2016
APRIL-2014

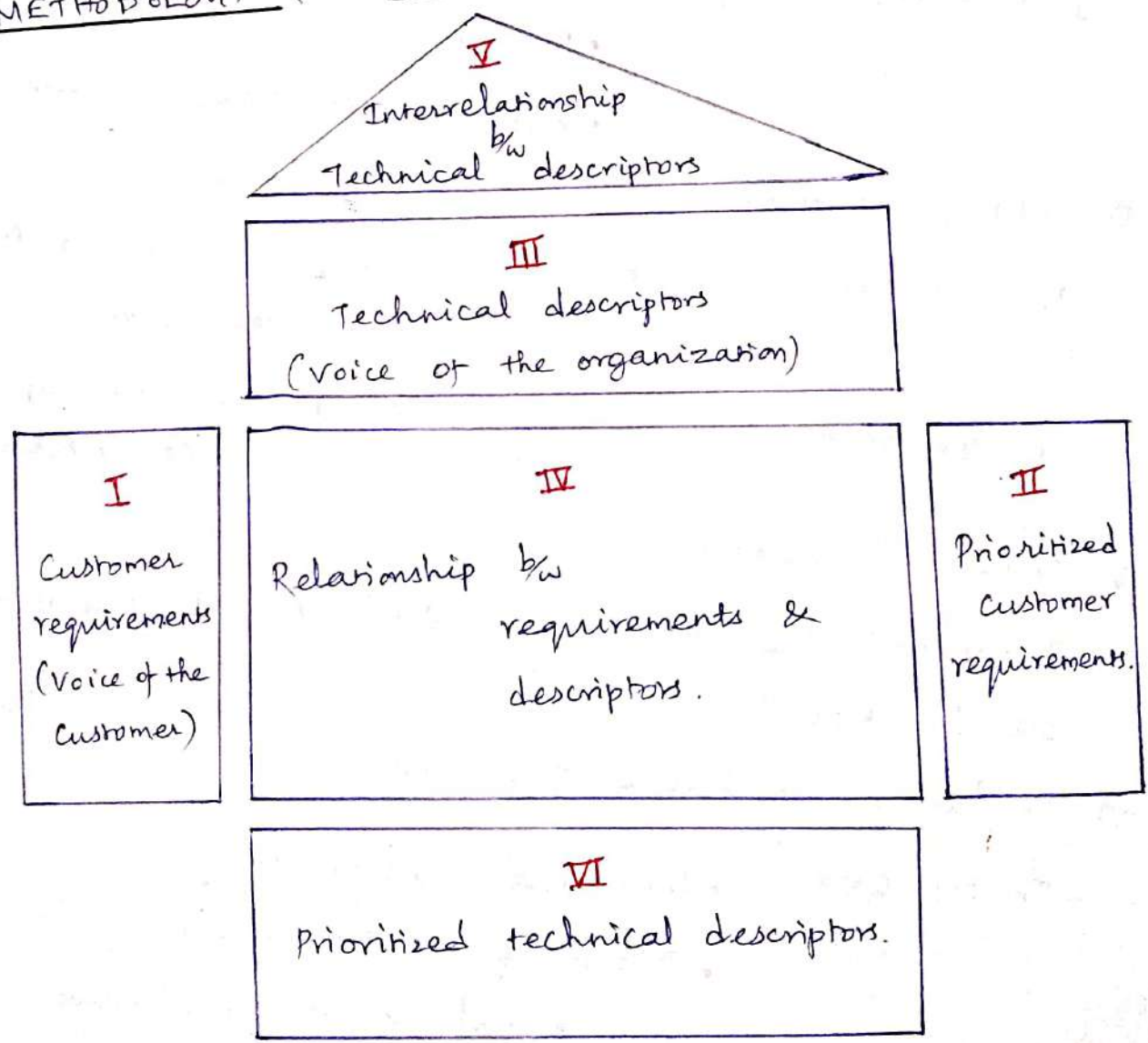
DEFINITION:

It may be defined as a system for translating consumer requirements into appropriate requirements at every stage, from research through product design & development, to manufacture, distribution, installation & marketing, sales & service.

Objective:

Translating customers voice (or requirements) into product specifications.

METHODOLOGY (or HOUSE OF QUALITY).



I. Customer requirements

- what the customer expect from the product is listed

II. Prioritized customer requirements:

- Some of the listed items include,

- Customer benchmarking,
- customer importance rating,
- Target value,
- scale-up factor, &
- sales point.

III. Technical Descriptors:

- In this case the following activities are located. They are

- Product design characteristics.
- expressed in Engg. terms.

IV. Relationship matrix:

- It is relationship between customer requirements & technical descriptors.

- It correlates customer requirements with product characteristics.

V. Trade-off matrix:

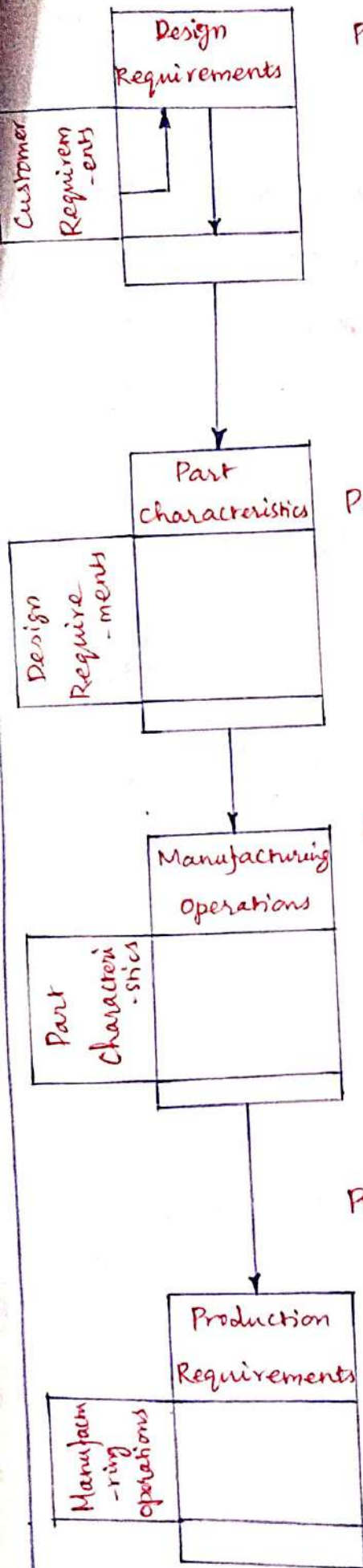
- Trade-off's b/w similar & /or conflicting technical descriptors are identified.

VI. Prioritized Technical Descriptors:

- In this case,

- Technical benchmarking,
- Degree of technical difficulty &
- target values are included.

QFD Process:



Product planning:

- List customer & technical descriptors.
- Develop a rel. matrix b/w WHAT's & How's & Interrelationship matrix b/w How's.
- Do competitive assessments.
- Develop prioritized customer & technical requirements descriptors.

Part Development:

- Deploy QFD process down to sub-components level both in-terms of requirements & characteristics.
- Deploy the component deployment chart. Relate the critical sub-component control characteristics.

Process planning:

- Develop the rel. b/w the critical characteristics & process used to create the characteristics.
- Develop the control plan relating critical control to critical processes.

Production Planning:

- Tabulate operating instructions from process requirements.
- Develop proto-type & do testing.
- Launch the final product to the market.

BENEFITS:

- ✓ (i) Promotes better understanding of customer demands.
- ✓ (ii) Improves customer satisfaction.
- ✓ (iii) Promotes team work.
- (iv) Facilitates better understanding of design interaction.
- (v) Involves manufacturing in the design process.
- (vi) Break down barriers b/w functions & departments.
- ✓ (vii) Concentrates on design effort.
- (viii) Minimises the no. of later engg. changes.
- ✓ (ix) Introduces new design to the market faster.
- ✓ (x) Provides better documentation of the design & dev.
- ✓ (xi) Reduces the overall costs of design & manufactur.

QUALITY LOSS FUNCTION:

DEFINITION:

The loss incurred by the producer or society from the time the product is shipped.

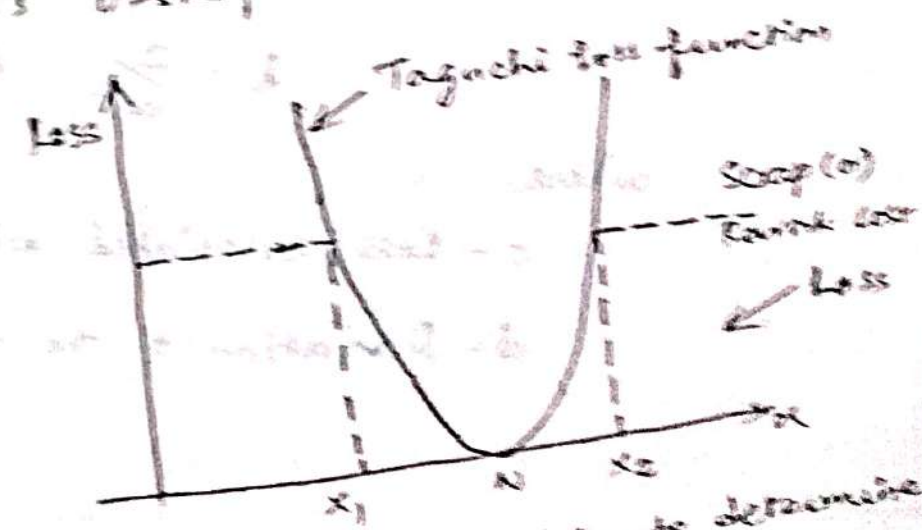
→ This loss includes,

- costs to operate,
- failure to function,
- maintenance & repair costs,
- customer dissatisfaction,
- injuries caused by poor design & similar costs.

EXPLANATION:

- As discussed, quality loss occurs when a product's specifications deviates from target (or) nominal value.
- No matter how small the deviation, there is some loss in quality.
- If the deviation grows, then the loss increases.
- The Taguchi's U-shaped loss function curve is shown in Fig. 1.

Fig. 1



• Taguchi uses a quadratic Equation to determine this curve.

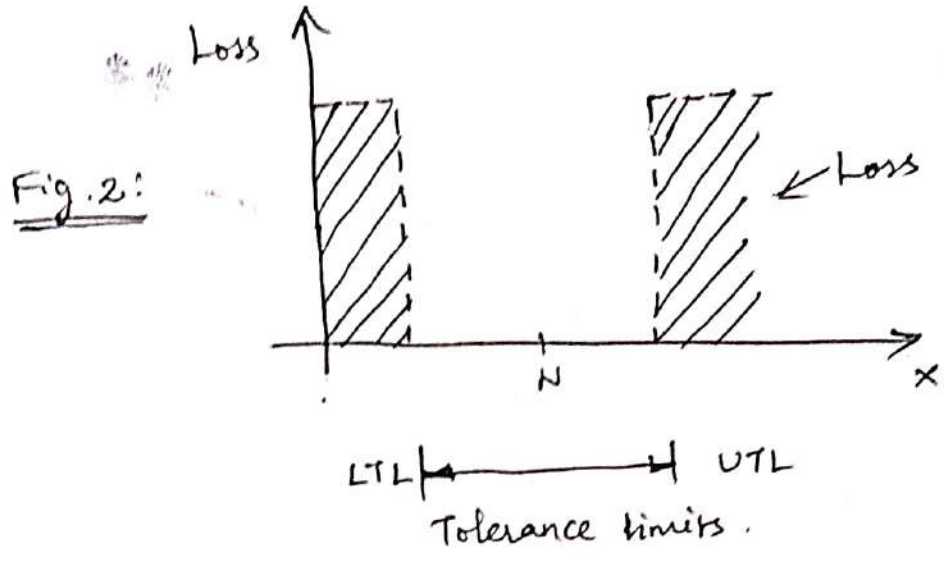
$$L(x) = K(x-N)^2$$

where $L(x)$ - loss function; K - constant of proportionality
 & N - nominal value of selected quality

N - Nominal value of the chosen product &

$(\sigma - N)$ - Tolerance.

- Loss function implicit in traditional tolerance specification



The figure shows the loss function is a traditional approach.

- In contrast, the smooth curve (Fig. 1) illustrates the Taguchi's approach.

To estimate the loss, the value of 'k' in equation should be determined as,

$$k = \frac{c}{d^2} \quad (\because k - \text{slope of quality loss function})$$

where,

- c - Loss associated with the specification limit x
- d - Deviation of the specification from the target value.

2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

DEFINITION:

It is the systematic execution of maintenance by all employees through small group activities.

✓ The dual goals of TPM are,

⇒ Zero breakdowns &

⇒ Zero defects.

OBJECTIVES:

(i) To improve equipment effectiveness:

- Identifying & examining all losses (down t, N & defect)

(ii) To achieve autonomous maintenance:

- People who operate equipment to take responsibility.

(iii) To plan maintenance:

- Systematic approach to all maintenance activities.

(iv) To train all staff in relevant maintenance skills:

- Continuous training to all operating & maintenance staff.

(v) To achieve early equipment management:

- aims to move towards zero maintenance through [P] prevent

BENEFITS:

→ Red equipment productivity & reliability, plant capacity, team work b/w operators & maintenance people, safety, return investment.

→ ↓ equipment down t.

→ Extended m/c life.

→ Lower maintenance & [P] costs.

→ Approaching zero equipment-caused defects.

→ Enhanced job satisfaction.

• ZERO-TECHNOLOGY: Interrelated activities has been described.

STEPS:

Stage	Step	Details
Preparation stage	① Top Mng. - To introduce TPM ② Launch education. ③ To promote teams. ④ Establish basic TPM policies & Goals ⑤ Formulate basic TPM Policies & Goals	- TPM Lecture in company, articles & Newspaper. - Use seminars & slide pres - Special committees at Top Medium & Low levels. - Analyse existing condition set goals & predict result - Prepare detailed Implementation plans.
Pre-liminary Implementation stage.	⑥ Hold TPM kick-off.	- Invite clients, affiliated & sub-contracting companies.
TPM Implementation Stage.	⑦ Improve effectiveness of each piece of equipment ⑧ Develop an autonomous maintenance program. ⑨ Develop a scheduled maintenance program ⑩. Conduct training to improve operation & Maintenance skills. ⑪. Develop early equipment Mng. program.	- select model eq. & form project teams. - Build skills & establish worker certification procedure - Include periodic & preventive maintenance & Mng. of spare parts, tools, blue prints & schedule. - Leaders share information with group members. - Design, commission & Control the maintenance prevention program.
Stabilisation stage	⑫. Perfect TPM implementation & raise TPM levels.	- Evaluate TPM & set higher goals.

6 6CA-LOSSES (OR) MEASURES OF 'TPM' (OR) Overall equipment Effectiveness:

Six-Big Losses	Calculation of overall equipment Effectiveness
1) Breakdowns 2) Setup & change over	• Availability = $\frac{\text{Loading Time} - \text{Down Time}}{\text{Loading Time}} \times 100.$
3) Idling & minor stoppages 4) Reduced speed	• Performance $\eta = \frac{\text{Theoretical cycle time} \times \text{No. of units}}{\text{Unit}} \times 100$ $\eta = \frac{\text{Theoretical cycle time} \times \text{No. of units}}{\text{Operating time}} \times 100$
5) Defects & rework 6) Start-up losses	• Rate of Quality products = $\frac{\text{Produced quantity} - \text{Defect quantity}}{\text{Produced quantity}} \times 100.$

• Overall equipment effectiveness = Availability \times Performance η \times Rate of Quality products

PERFORMANCE MEASURES:

[MAY/JUNE-2013]

- Performance measures indicates the measurement of success in an organization.

Objectives:

- To establish baseline measures & reveal trends.
- To determine which processes need to be improved & overall performance of the organization.
- To indicate process gains & losses.
- To compare goals with actual performance.
- To provide information to make informed decisions & individual & team evaluation.

Indicators:

- (i) Customers - No. of customers' complaints & warranty claims.
- (ii) Production - $\frac{[O/P]}{[I/P]}$.
- (iii) Suppliers - on-time delivery.
- (iv) Research & Development - new product time to market.
- (v) Human Resources - No. of training hrs/employee. & Active tea
- (vi) Marketing/sales - Sales & Market growth.
- (vii) Administration - Cost of poor quality.

Requirements:

- (i) Performance measures should be simple & understandable to the users.
- (ii) It is preferable to use few no. of key measures.
- (iii) While selecting measures, one should select the measures which are more relevant to customers.
- (iv) It focuses on continuous improvement, prevention & corrective action.

(v) Cost related [PM] - better understand the financial position of the firm.

(vi) It's selected / used should be transparent & visible to all employees.

(vii) It is time based.

(viii) The results should be balanced the interests of all stakeholders.

• Strategy:

✓ Quality → % ↑ in Quality grade.
→ % ↓ in failure rate, cost of poor quality, rejects & scrap, safety & Environmental incidents.
→ reduction in no. of customer's complaints.

✓ Throughput time.
→ reduction in throughput time, No. of breakdowns, time b/w order & delivery.
→ ↑ mfg. cycle effectiveness, availability & invoicing speed.

✓ Productivity.
→ ↑ in productivity, effectiveness, revenue growth, sales & market growth.
→ % reduction in personnel turnover.

✓ Added value.
→ ↑ in revenue / employee & Gross & Net added value.

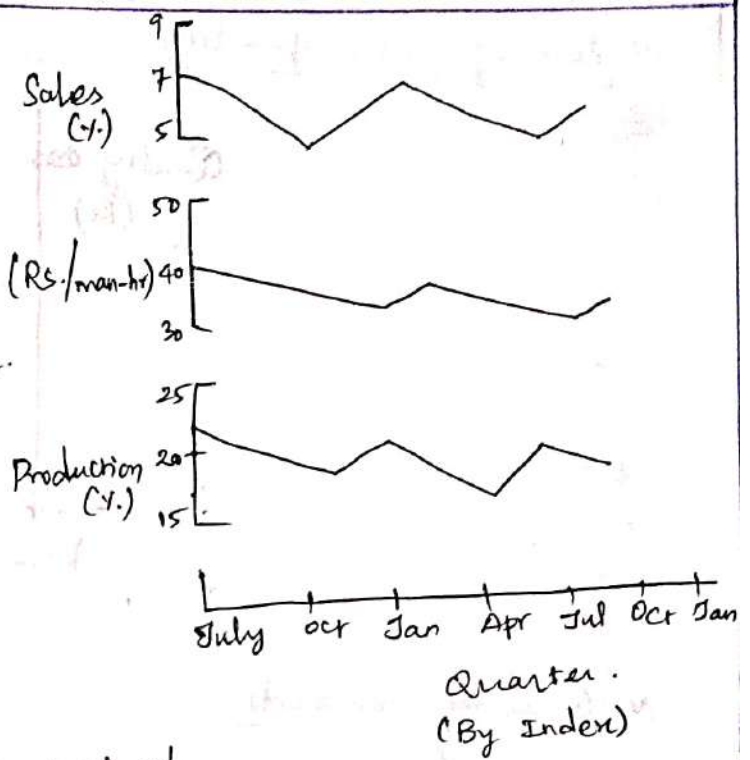
PRESENTATION:

i) Time series trend graphs:

Time is represented on X-axis.

Direct labours.

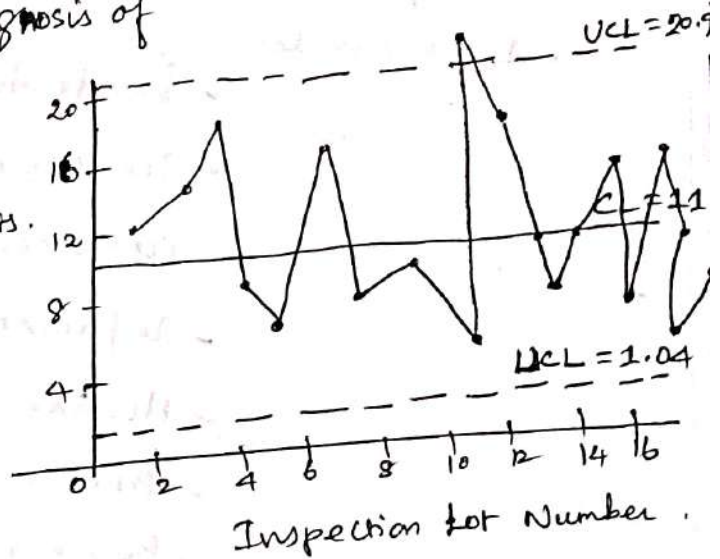
Performance measure is represented on Y-axis.



ii) Control charts:

- It is powerful tools for the diagnosis of quality problems.

No. of defects.



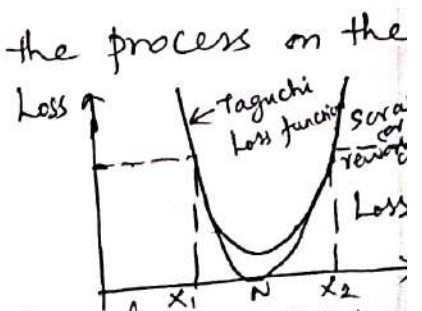
iii) Process capability index:

→ Tolerance
Capability.

a) C_p - It measures the ability of the process to meet specifications.

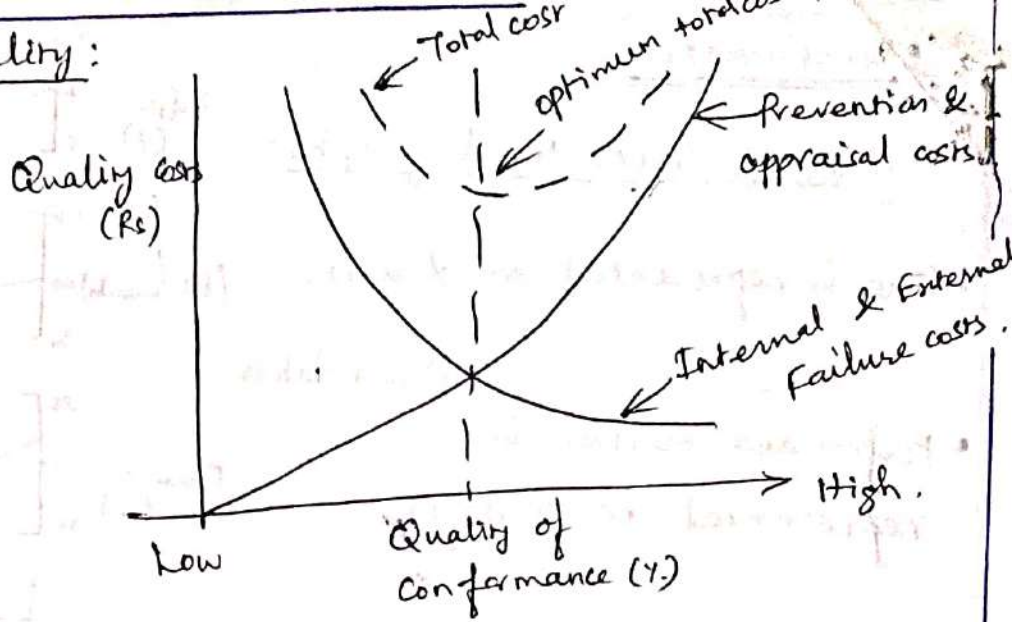
b) C_{pk} - It indicates the centering of the process on the target.

iv) Taguchi's quality loss function:



- It is based on the fact that quality loss occurs when a product's specifications deviates from target (or) nominal value.

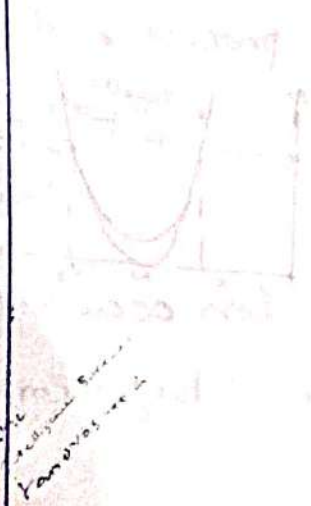
(v) Cost of poor quality:



(vi) Quality awards:

- It includes,

- ✓ Leadership.
- ✓ Strategic planning,
- ✓ customer & market focus,
- ✓ Information & analysis,
- ✓ Human resource focus,
- ✓ process Management, &
- ✓ Business results.



UNIT - V

QUALITY MANAGEMENT SYSTEM

INTRODUCTION:

- ISO - International Organization for standardisation.
- The Quality systems are the organization structures,
 - ✓ responsibilities,
 - ✓ Procedures,
 - ✓ Processes &
 - ✓ Resources for Implementing Quality Mng.

NEED FOR ISO-9000:

- Every organization is concerned with the Quality of its product or service.
- To assure the quality one has to ensure the Quality.
- To ensure the quality it is necessary to make quality assurance systems.
- Sound Quality assurance system requires well defined quality system standards.
- Quality and standard are the two essential pre-requisites for an organization to market its products and services in the competitive business environments. Thus Quality begins with standards.
- Also the ever increase the pressure to provide better Quality of products / services led to the development of quality standards.

NOTE:

TYPES OF ISO:

- (i) ISO 9001:2008 - Quality Mng. System.
- (ii) ISO 37,001 - Anti-bribery Mng. System.
- (iii) ISO 31,000 - Risk Mng.
- (iv) ISO 27,001 - Information Security Mng. System.

ISO 9000 QUALITY SYSTEMS: ELEMENTS:

• ELEMENTS: (or) CLAUSES (or) QUALITY SYSTEMS REQUIREMENTS:

a) MNG. RESPONSIBILITY:

- Mng. should define and document its Quality Policy & objectives.
- Responsibility, Authority & interpolation of all the employees should be clearly defined.

b) QUALITY SYSTEMS:

- It includes preparation of Quality Manual, procedures, process work instructions, workmanship standards, Drawing Specifications and relevant Quality records.

c) CONTRACT REVIEW:

- Customer's requirements should be formally reviewed to ensure that the supplier is capable in terms of both technical and organization requirements.

d) DESIGN CONTROL:

- Both the design input (like specifications) and the design output (like Drawings) should be identified and documented.

e) DOCUMENT CONTROL:

- Various document includes Quality Manual, Quality system procedures, work instructions, Quality plans & Quality records.

f) PURCHASING:

- It is applicable to raw materials, components (like both purchased & sub-contracted) which are likely to affect the product.

g) PURCHASER SUPPLIED PRODUCT / CONTROL OF CUSTOMER-SUPPLIED PRODUCTS

- It lays down the responsibility for preventing damage (or) loss and the same to be recorded & reported to the customer.

h) PRODUCT IDENTIFICATION AND TRACEABILITY:

- It is correctly identified throughout the production process.
- Traceability method ^{by} which the item can be identified.

l) PROCESS CONTROL:

- Each process has to be performed under controlled conditions.
- Quality system procedure, std's & Quality plans, Monitoring & control of specified process parameters and production characteristics, Approval of process as specified in Quality systems, Maintaining workmanship std's., Continuous monitoring to ensure continuous process capability.

j) INSPECTION & TESTING:

- Receiving inspection & Testing.
- In-process inspection & Testing.
- Final inspection & Testing.

k) Inspection, Measuring and Test equipment.

l) Inspection & Test Status.

m) Control of Non-conforming products.

- Identification, Documentation, Evaluation, Segregation & Disposal of non-conforming products like Rework, Repair, Acceptance with Concession.

n) Corrective & Preventive action.

o) → Effective handling of customer complaints.

- Continuous study & analysis of various sources of information.

p) Handling, Storage, Packaging, Preservation & Delivery.

q) Control of Quality Records.

- Contract Review, Sub-contractor assessments, Test records, Calibration Data etc.

r) Internal Quality Audit. (self - Evaluation mechanism).

s) Training.

- How training needs of personnel are identified, organized, implemented & monitored.

t) Servicing: It will planned & executed wherever it is a specified requirement.

u) Statistical Techniques: Pareto Analysis, Histograms, PERT, etc.,

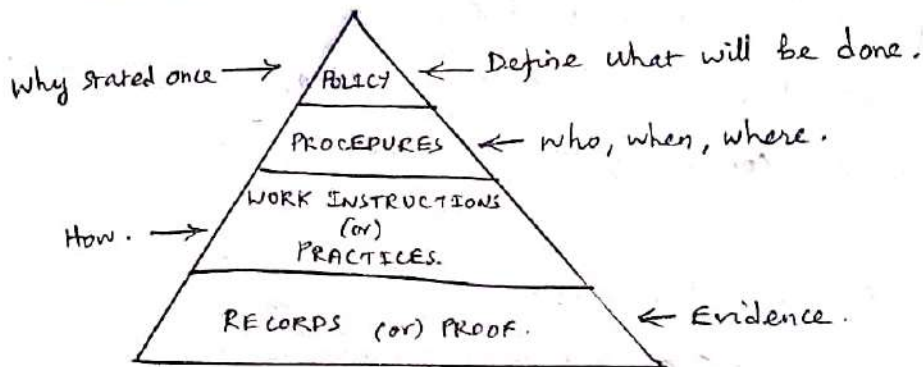
DOCUMENTATION:

• It serves as a reference for the management, the staff & other agencies whose involvement is essential for implementation of the Quality systems.

Advantages:

- It serves as a reference.
- It brings about clarity of objectives and targets.
- It provides std in work procedures.
- It brings about consistency in operations,
- It develops confidence amongst employees.
- It generates customer's confidence.
- It provides a basis for Continuous improvement.

PYRAMID:



BENEFITS:

- Regularises the method of performing the day-to-day activities.
- It provides format for std. practices.
- It reference for assessing degree of enforcement in practice.
- It facilitates trouble shooting for tracking back on the processes.
- It demonstrates the ISO Quality system certification.

QUALITY AUDITING:

DEFINITION:

A systematic & independent examination to determine whether quality activities and related company with planned arrangements, whether these arrangements are implemented effectively and whether these are suitable to achieve objectives.

FEATURES:

- Typically applies to quality system (or) elements. [Processes, Products (or) services.]
- Carried by staff who are not directly responsible in the area's being audited.
- Information gathering activity.
- It conducted for internal (or) external purposes.

TYPES:

(i) 1st Party Audit (or) Internal Audit.

→ Audit is done by an organization working on itself.

(ii) 2nd Party Audit.

→ Audit by one organization on another organization.

→ Ex: Supplier by a customer.

(iii) 3rd Party Audit.

→ Audit by an independent organization on a supplier for accreditation assessment purposes.

OBJECTIVES:

- To determine the conforming (or) non-conforming of the Quality system elements with regard to specified requirements.
- To determine the effectiveness of the implemented Quality system in meeting specified Quality objectives.
- To meet regulatory requirements.
- To permit the listing of the audited organisations Quality system in a register for 3rd party certification.

→ To evaluate an organisation's own Quality System against a Quality System.

• STAGES:

(i) Audit Planning:

→ Audit Schedules, Personnel, Notification to the auditee & preparation of check-list.

(ii) Audit Performance:

→ Opening & Entry meetings, Audit process and deficiencies.

(iii) Audit Reporting:

→ Summarising the audit findings.

(iv) Audit Follow-up:

→ Identifying the non-conformity.

QS 9000 (or) AUTOMOTIVE QUALITY MANAGEMENT SYSTEMS:

It focuses on helping automotive suppliers to ensure that they are meeting (or) exceeding automotive requirements.

• OBJECTIVES:

It develops fundamental quality systems based on,

a) Continuous improvement.

b) Direct prevention.

c) Reduction of variation and

d) Waste elimination in the automobile supply chain.

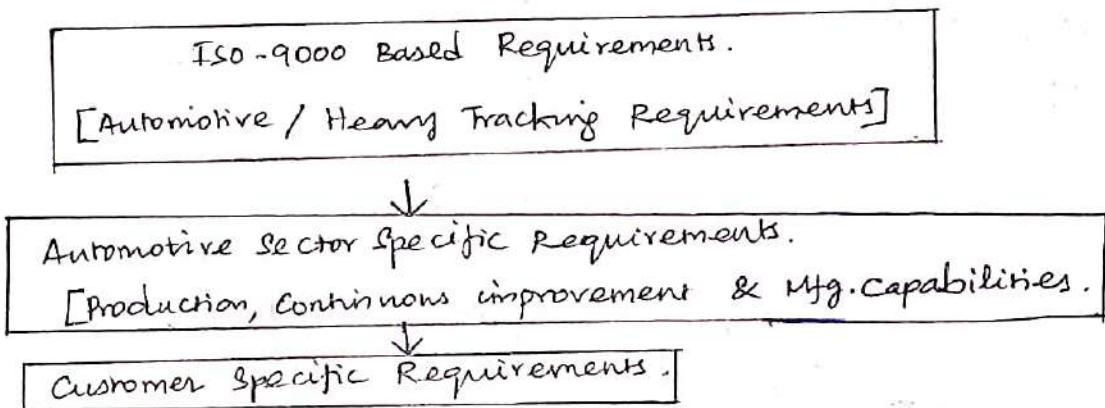
• APPLICATIONS:

→ Production materials,

→ Production (or) Service parts &

→ Heat Treating, Painting, Plating (or) Finishing services.

• STRUCTURES:



• DOCUMENTS REQUIRED:

→ QS-9000, Quality system requirements,

→ Advanced product quality planning & control plan,

→ FMEA,

→ Measurement system analysis,

→ Fundamental Statistical process control,

→ Production part approval process manual, and

→ Quality system Assessment Manual.

ISO-14,000 (or) ENVIRONMENTAL MANAGEMENT SYSTEM [EMS].

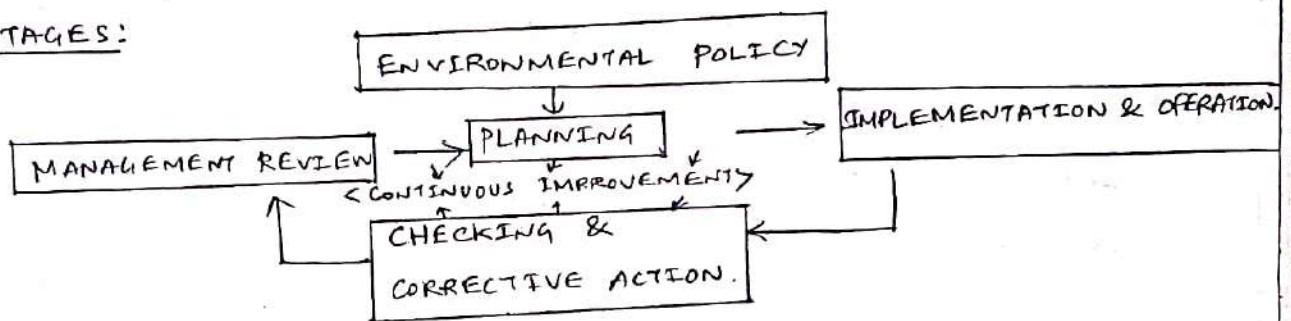
It brings a world-wide focus to the environment, encouraging a cleaner, safer, healthier world for all.

• CONCEPT:

→ It can be applicable to all types & sizes of organization and to accommodate diverse geo-graphical, cultural and social conditions.

→ EMS approach is based on PDCA cycle.

• STAGES:



a) ENV. POLICY:

- Mng. commitment to continual improvement.
- Prevention of pollution, Laws & Regulation, Co-operation with Public authorities.
- Creating a framework for setting objectives.
- Communication requirements, Education and Training.

b) PLANNING:

- Env. aspects, Legal requirements, objectives & Targets, Env. Mng. Program.

c) IMPLEMENTATION & OPERATIONS:

- Structure & Responsibility, Training, Awareness, Competency, Communication, EMS documentation, Document control, operational control, Emergency preparedness & Response.

d) CHECKING & CORRECTIVE ACTION:

- Monitoring & Measuring, Non-conformance & Corrective-preventive action, Records & EMS Audit.

e) MNG. REVIEW:

- To ensure the continuing suitability, adequacy & effectiveness of EMS.

TQM IMPLEMENTATION IN MANUFACTURING AND SERVICE SECTORS:

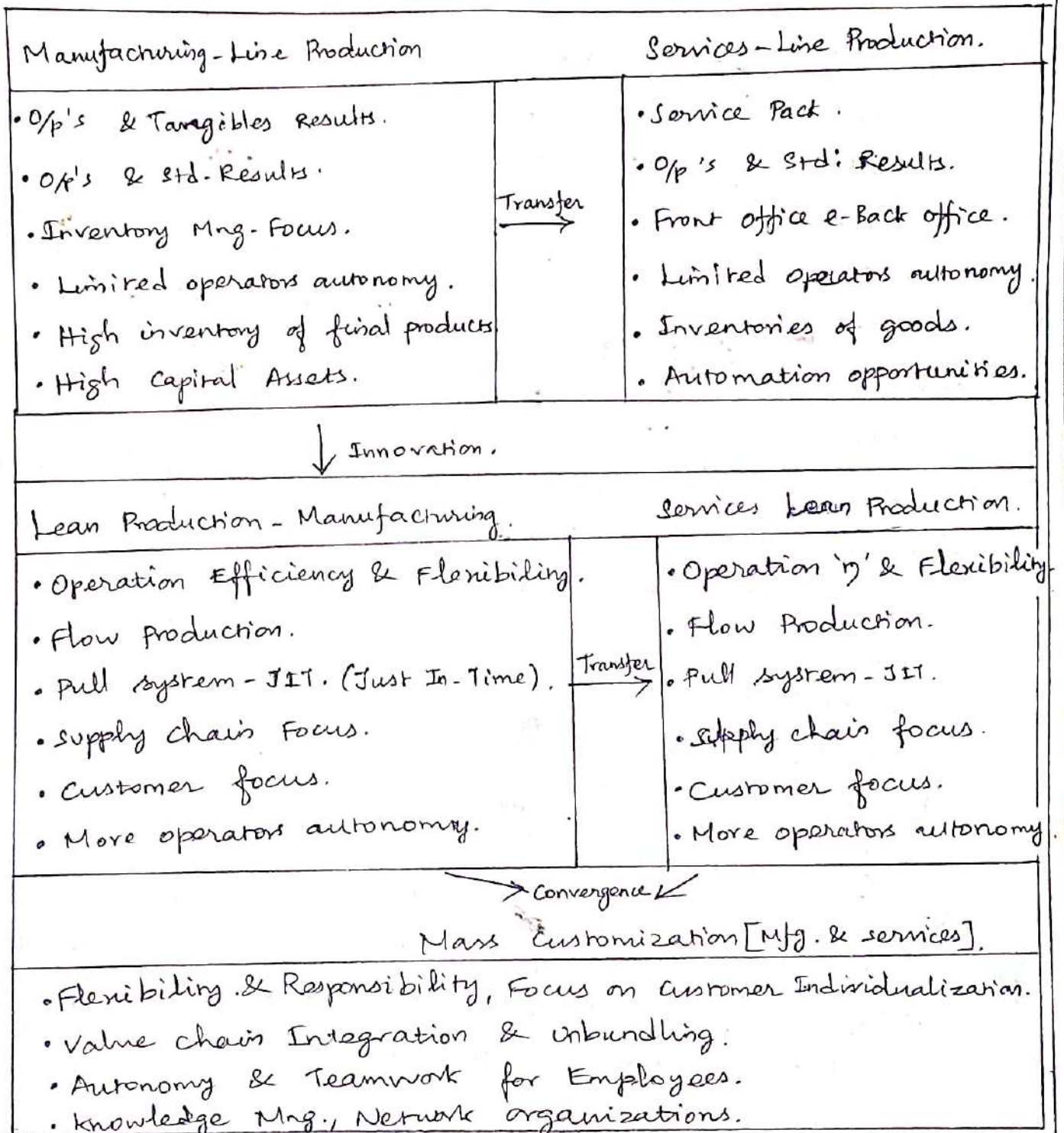
1. A user of service has a few characteristics and attributes in mind that he (or) she uses as a basis for comparison among alternatives.
2. Customer expectations before the service vs their actual experience with the service.
3. The research also indicated that customers, across a broad range of service businesses, have the following expectations,
 - Reliability (Consistency).
 - Responsiveness (Speed).
 - Assurance (Competence).
 - Empathy (Customer orientation).
 - Tangibles (what can see, feel, smell, hear & Taste.)
4. Service Quality Types:-
 - Normal - Quality level at which the regular service is delivered.
 - Exceptional - Quality level at which the "expectations" (or) Problems are handled.
5. TQM Tools.
 - Taguchi Method - Pareto charts - Process charts - Cause & Effect diagram
 - Statistical Process Control.
6. Taguchi Method:
 - a) Quality Robustness.
 - b) Quality Loss function.
 - c) Target value - continuous improvement.
7. → Method of organizing errors, Problems (or) defects to help focus on the "critical few factors" in Problem solving efforts.
→ They are designed to help us understand a sequence of events through which a product travels.

→ One of many available tools helpful is identifying possible causes of quality problems. [cause and Effect Diagrams].

8. It is concerned with monitoring standards.

- Making measurements & Taking corrective actions as a product (or) Service is being produced.

CONVERGENCE OF SERVICES & GUIDELINES OF MFG. PRODUCTION.



AS 9100D:

- * The AS 9100 Rev D standard is the Quality Management System (QMS) standard for the Aviation, Space & Defense industries.
- * AS 9100 D is based on the ISO 9001:2015 quality management standard.
- * Both standards are organized in the same way and use the same basic numbering system.
- * AS 9100 D standard gives you a set of guidelines to help make sure that you don't miss any important elements so that your aero-space QMS can be successful.
- * SEVEN PRINCIPLES OF AS 9100 D:

① Customer Focus:

- Meet customer needs & expectations.
- Determine levels of customer satisfaction / Dissatisfaction.
- Strive to exceed customer expectations.

② Leadership:

- Establish purpose & give direction to the company.
- Engage people in achieving quality objectives.

③ Engagement of people:

- Focus on competency.
- Empower & engage people in delivering value.
- Identify & manage human factors of the work place.

④ Process Approach:

- Systematically identify & manage the process employed.
- Understand activities & manage them as interrelated processes to get consistent predicted results.

⑤. Improvement:

→ Organizations will maintain current levels of performance, respond to changing conditions & identify, create & exploit new opportunities when they establish & sustain an on-going focus on improvement.

⑥. Evidence-based decision making:

→ Organizations succeed when they have established an evidence based decision making process.

⑦. Relationship Management:

→ Organizations that carefully manage their relationships with suppliers & partners can nurture positive & productive involvement, support & feedback from those entities.

STRUCTURE OF AS 9100 D:



BENEFITS:

- Enhance global marketability.
- Enhance customer satisfaction.
- Ensure product safety & reliability.
- Improve the balance sheet & profitability.
- Standardizes on one audit body & eliminates multiple assessments in the aviation industry.

TL 9000:

* The purpose of TL 9000 is to define the telecommunications quality system requirements for the design, development, production, delivery, installation and maintenance of products and services.

* Included in TL 9000 are performance & cost-based metrics that measure reliability & quality performance of the products & services.

* USES:

- Improve services.
- Increase satisfaction.
- Increase quality.
- Improve bottom line.
- Improve efficiency.
- Enhanced supplier relationships.
- Increased competitiveness.
- Creation of a platform for improvement initiatives.
- Continuous improvement.

* EXPLANATION:

①. Combining efforts:

- Bell Atlantic, Bell-South, Pacific Bell & Southwestern Bell.
- The QUEST Forum.

②. Global harmonization:

- Include suppliers & companies.
- Create extension to ISO 9000.

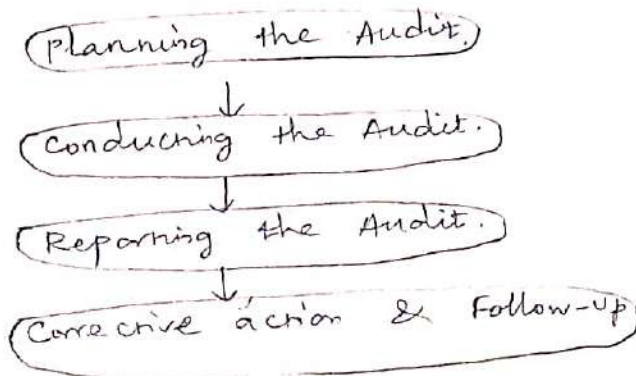
③. Goals of improving quality:

- Creating a standard.

ISO/

TS 16949: AUTOMOTIVE QUALITY MANAGEMENT:

- * The globally recognized Quality Management Standard for the automotive industry.
- * It brings together standards from across Europe & the US & provides a framework for achieving best practice with regards to the design & manufacture of products for the automotive supply chain.
- * It is an ISO technical specification aimed at the development of a quality management system that provides for continual improvement, emphasizing defect prevention & the reduction of variation & waste in the automotive industry supply chain.
- * Internal Audit to ensure compliance for Re-certification is required before the expiry of the 3 year period.



* Five layers dealing with ISO 90011 & hardware, software and service requirements.

- ① Requirement clauses of the International standards ISO 90011
- ② Common Tele-Communications Industry requirements that apply to hardware software services.
- ③ Contains those requirements that are specific to hardware, software & services.
- ④ Common Telecommunications Industry measurements that apply to hardware, software & services.
- ⑤ Provides measurements - The measurement tools to be used with hardware, software and/or services processes & products - to be used to measure results relative to the requirements.

* Registration:

- Established by the QUEST Forum.
- For suppliers & Telecommunications companies around the world.
- Working with Registrar Accreditation Board.
- Percent Market share of TL 9000 Registrations.

* QUEST Forum:

- 150 members.
- Open to telecommunications service providers & suppliers.
- Coordinates the global TL 9000 effort.

BASIC REQUIREMENTS OF ISO 9001:

- ①. Procedure to cover all processes in the business.
- ②. Monitoring process to ensure effectiveness.
- ③. Keeping adequate record.
- ④. Defect verification & appropriate correction.
- ⑤. Regular review of individual processes.
- ⑥. Facilitating continual improvement.

HOW TO IMPLEMENT A QUALITY MANAGEMENT SYSTEM IN 8 STEPS:

- ①. Familiarize Yourself with ISO-9001.
- ②. Plan Everything out for Implementation.
- ③. Identify Responsibilities, Policies & objectives.
- ④. Develop your Documentation.
- ⑤. Launch Your Quality Management System.
- ⑥. Review Your Performance.
- ⑦. Assess & Register for certification.
- ⑧. Continual improvement.