Unit I - Introduction

Introduction :-

* Introduction To Quality :- (Ref Page No.4)

- Earlier product was governed by the individual skill and it differed from instance to instance depending upon the creator & the process used to make it at instance.

- Every product was considered as separate project & every instance of the manufacturing process led to products of different quality attributes.

- Due to increase in demand for same or similar products which were expected to satisfy similar mechanism of the manufacturing products.

- The market is changing considerably from monopoly to fierce competition but still maintaining the individual product identity in terms of attributes & characterstics.

- There are large number of buyers and sellers in market providing & demanding similar products which satisfy similar demands.

- Products may or may not be exactly the same but may be similar or satisfying similar needs / demands of the user.

- They may differ from one another to some extent on the basis of their cost, delivery schedule to acquire it, features, functionalities present/absent.

- These may be termed as attributes of the quality of a product.

* <u>Historical Perspective of Quality :-</u> (Ref Page No 4)

- The term quality means different things to different people at different times, different places and for different products.

- For example : to some users, a quality product may be one, which has no/less defects and works exactly as expected and matches with his/her concept of cost and delivery schedule along with services offered. Such a though may be a defination of quality. Quality is fitness for use.

- Quality defined as conformance to specifications. is a position that people in the engineering industry often promote because they can do very little change the design of a product and have to make product as per the design which will best suite the user's other expectations like less cost, fast delivery and good service support.

- Quality is the extent to which the customers/ /users belive that a product meets or surpasses their needs and expectations.

- Other belive that quality means delivering products that:

① meet customers standards either defined by the customer or defined by the normal usuage or by some national or international bodies.

② meet and fulfill customer needs which include expressed & implied requirements deliverd by business analysts and system analysts.

③ One must try to meet customer expectations as maximus as possible. If something is given

than the customer requirement, it should be declared before transition so that customer surprises can be avoided.

④ Meet anticipated / unanticipated future needs and aspirations of customers by understanding their businesses & future plans. One may need to build a software & system considering some future requirements. Every product has some defined life span & one may have to extrapolate future needs accordingly.

* Definations of Quality :- (Ref. pag. No. 6)

- For achieving quality of product one must define it in some measurable terms which can be used as reference to find whether quality is met or not.

- There are many views and definitions of quality given by stalwarts working in quality improvement & quality management arena.

- Some of these are

① Customer - Based Defination of Quality :-
- Quality product must have fitness for up and must meet customer needs, expectations & help in achieving customer satisfaction & possible customer delight.

② Manufacturing - Based Defination of Quality :
- This defination is mainly derived from engineering product manufactring where it is not

expected that the customer knows all requirement of the product and product level requirements are defined by architects & designers on the basis of customer feedback/ survey.

③ Product-Based Definition of Quality :-
The product must have something that the other similar products do not have which can help the customer satisfy his/her need in a better way.

④ Value-Based Definition of Quality :-
A product is the best combination of price and features or attributed expected by or required by the customer. The customer must get value for this investment by buying the product.

⑤ Transcendent Quality :-
To many users/ customers it is not clear what is meant by a quality product but as per their perception it is something good and they may want to purchase it because of some quality present/ absent in product.

- A product must zero/ minimum defects so that it does not prohibit normal usuage by the user.
- A product must be something that people will want to receive as it satisfies their needs & support expectations. It must suffice the purpose of its existence from customer view.

※ <u>Core Components of Quality</u> :- (Ref. Page No 7)

- Quality of a product must be driven by customer requirements & expectations from the product. Those expectations may be expressed as a part of requirement specifications defined or may be implimed which is generally accepted as the requirements.

Some postulates of quality are.

① Quality is based on customer satisfaction by acquiring a product.

- Quality is something preceived by a customer while using a product.

- The effect of a quality product delivered and used by a customer, on his satisfaction & delight is the most imp factor in determing whether the quality has been achieved or not.

- It talks about the ability of a product or service to satisfy customer by fulfiling his needs or purpose for which it is acquired.

- It may come through the attributed of a product, time required for customer to acquire.it, price a customer is expected to pay for it & so many other factors associated with the product as well as the organization producing it.

- Producer must understand the purpose or usuage of a product & then devise a quality plan for it accordingly to satisfy the purpose of the product.

② The organisation must define quality parameters before it can be achieved

In order to meet some criteria of improve-ment & ability to satisfy a customer one must follow cycle of define, measure, control & Improve.

(i) Define :-

There must be definition of what is required in the product in terms of attributes of a product. & in how much quantity it is required to derive customer satisfaction.

(ii) measure :-

The quantitative measure must be defined as an attribute of a product.

(iii) monitor :-

Ability of the product to satisfy customer expectations defines the quality of a product.

(iv) control :-

control gives the ability to provide desired results & avoid the undesired things going to a customer

(v) Improve :-

Continuous improvements are necessary to maintain ongoing customer satisfaction & overcome the possible competition, customer complaints.

③ management must lead the organization through Improvement Efforts.

Quality must be perceived by a customer to realise customer satisfaction.

④ Continuous Process (continual) Improvement is necessary.

The first step for producing quality is the defination of processes used for producing the product & the cycle of continuous improvement to refine processes to achieve target improvement.

Continuous Improvement	Continual Improvement
① Continuous improvement is dynamic in nature.	Continual improvement is dynamic & static change management.
② The changes are done at every stage & every time.	The changes are done, absorbed, baselined & sustained before taking next step of improvement
③ Continuously striving for the excellence gives a continuous improvement.	Periodic improvements followed by stabilisation process.
④ It has high dependence on people having innovative skills tending towards inventions.	Less dependence on people and more dependence on innovation processes.
⑤ Environment is continously changed	changed in enviroment are followed by stabilisation

* Quality View :- (Ref Pag.No.10)

Stakeholders are the people or entities intrested in success/ failure of a project or product or organisation in general. Quality is viewed differently by different stakeholders

① Customer's view of Quality :-
- customer is the main stakeholder for any product. The customer will be paying for the product to satisfy the his requirements.
- Customers view of quality of product interprets customer requirements & expectation for getting a better product at defined schedule, cost & with adequate service along with required features & functionalities.

    i) Delivering right product
    ii) satisfying customer's needs
    iii) Meeting customer expectations
    iv) Treating every customer with integrity, courtesy & respect.

② Supplier's view of quality
Suppliers give inputs for making product/ project. suppliers can make more business, profit, expansion. suppliers can be external or internal to the organization. Supplier expectations may range from profitability, name in market, repeat orders, customer satisfaction. These expectations may be diff^n ways

    i) Doing the right things.
    ii) Doing the right way
    iii) Doing it right the first time
    iv) Doing it on time.

* <u>Financial Aspect of Quality</u> :- (Ref. Page No 15

- Earlier people were of the opinion that more price of a product represents better quality as it involves more inspection, testing, sorting and ensures that only good part are supplied to customer.

Sales price was defined as,

<u>Sales price = Cost of manufacturing +</u>
                          cost of quality +
                          Profit.

Reducing Sales price reduces percentage profit. For maintaining profit the producer may try to reduce the cost of production without compromising on the quality aspect.

Thus in competitive environment the equation changes to

Profit = Sales price - [cost of manufacturing + cost of quality]

① <u>Cost of manufacturing</u> :-
- It is cost required for developing the right product by right method at first time. The money involved in resources like material, people, licenses etc forms of cost manufacturing.

- The cost involved in requirement analysis, designing, development & coding are the cost associated with manufacturing.

② Cost of Quality :-

-cost of quality represent the part of cost of production incurred in improving quality of product.

- cost of quality includes includes all the efforts and cost incurred in prevention of defects, appraisal of product to find whether it is suitable to customer or not and fixing of defects or failure, at various levels of any when they are reported and conducting any retesting, regression testing. etc

① Cost of prevention
ⅱ) cost of appraisal.
ⅲ) cost of failure.

-On the basis of quality focus organisation may be placed in 2 categories viz. organisations which are less quality conscious (termed as q) and organisations which are more quality conscious (termed as 'Q') . The distribution of cost of quality for these two types may be represented as below

fig. Less quality conscious

(q)

Failure		failure
		failure
Appraisal		Appraisal
Prevention		Prevention
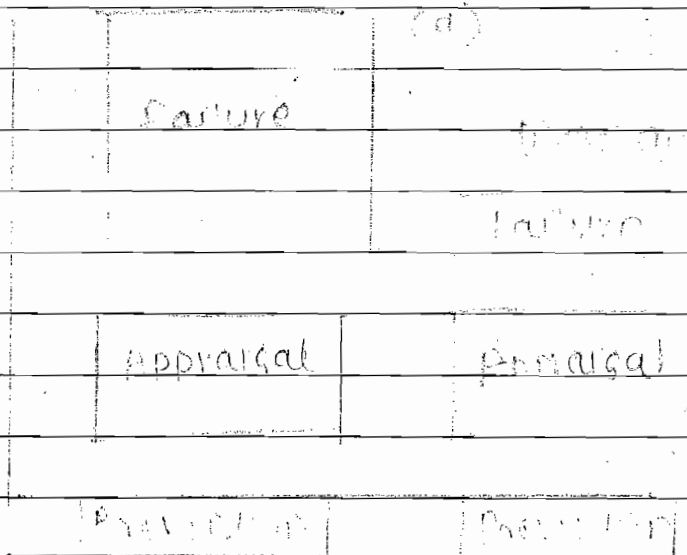
* <u>Customeres, Suppliers and Processes</u> :- (Ref pag No 18)

- For any organisation, there are some supplier supplying the inputs required and some customers who will be buying the output produced.
- Suppliers and customers may be internal or external to the organisation.
- External suppliers provide input to the organisation and external customer receive the output of the organisation.
- Suppliers may be customers for some other organisations and customers may be acting as suppliers for somebody else down in line.

① Internal Customer :-

- Internal customers are in the functions & projects serviced and supported by some other functions/ projects.
- System administration may have projects as their customer while purchasing as their customer while may have their customer.
- During value chain each function must understand its customers and suppliers.

② External Customer :-

- External customer are the external people to the organization who will be paying for the services offered by organization.
- There are the people who will be actually buying products from the organization.

* Total Quality Management (TQM) (Ref. page No. 18)

'Total quality management' principle intends to view internal & external customers as well as internal & external suppliers for each process, project and for entire organisation as a whole.

The process and factions of an organization can be broken down into component elements, which act as suppliers/ customer to each other during the workflow.

Each supplier eventually also becomes a customer at some other moment and vice versa.

If one can take care of his/ her customer with an intention to satisfy him it may result into customer satisfaction and continual improvement for the organization.
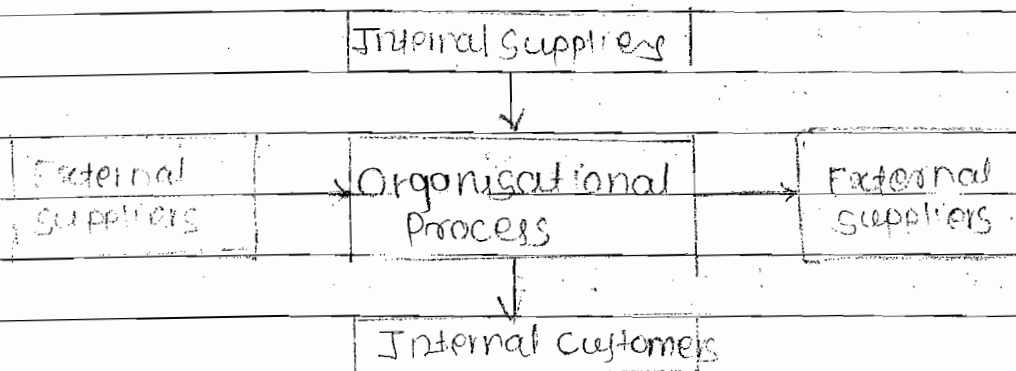
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              ┌─────────────────────┐
              │  Internal Suppliers │
              └─────────────────────┘
                         │
                         ▼
┌────────────┐   ┌─────────────────┐   ┌────────────┐
│ External   │──▶│ Organisational  │──▶│ External   │
│ Suppliers  │   │   Process       │   │ suppliers  │
└────────────┘   └─────────────────┘   └────────────┘
                         │
                         ▼
              ┌─────────────────────┐
              │  Internal Customers │
              └─────────────────────┘
```

fig Supply chain relationship b/t suppliers and customers

- Total Quality Management is the appln of quality principles to all facets and business process of an organization.

- It talks about applying quality methods to the entire organization whether a given funn or part of the organisation faces external customer(s) or not.

* <u>Quality Practices in TQM</u> (Ref. Page No 19)

Total Quality management works on some basic principles of quality management defination and implementation. These have evolved in over a span of experimentation and deployment of quality culture in organisations.

① Develop constancy of purpose of defination & deployment of various initiatives.

② Adapting to new philosophy of managing people/ stakeholders by building confidence & relationships.

③ Declare freedom from mass inspection of incoming produced output.

④ Stop awarding of lowest price tag contracts to suppliers.

⑤ Improve every process used for development & testing of product.

⑥ Institutionalise training across the Organisation for all people.

⑦ Institutionalise leadership throughout oraganisation at each level.

⑧ Drive out fear of failure from employees.

⑨ Break down barriers between functions/department

⑩ Eliminate exhortations by numbers, goals, targets.

⑪ Eliminate arbitrary numerical targets which are not supported by process.

⑫ Permit pride of workmanship for employees.

⑬ Encourage eduction of new skills and techniques.

⑭ Top management commitment & action to improve continually.

* Quality management through statistical process control. _(Ref. page No 22)_

- Dr Joseph Juran is a pioneer of statistical quality control with a defination of improvement cycle through define, measure, monitor, control and Improve (DMMCI)

- There are three approach to understand the interrelationships among customers, suppliers & processes used in development, testing etc & establish quality management based on metrics program.

① **Quality planning at all levels :-**

- Quality is not an accident but is a result of deliberate effort to achieve something which is defined in advance.

ⓘ **Quality planning at organisation level :-**

Quality must be plannet first in the form of policy defination and strategic quality plans on the basis of vision, mission(s) and polices set by senior management

ⓘⓘ **Quality planning at unit level :-**

- Quality planning at unit level must be done by the people responsible for managing unit.

- operational quality plans must be sink with organisational policies and strategies.

② **Quality Control :-**

- Quality control process attempts to examine the present product at various levels with the defined standards so that an organisation may appraise the outcome of the processes.

③ Quality Improvement

Improvement process attempt to continuously improve the quality of the process used for producing products.

* Quality management through cultural changes :-
   (Ref pag No. 23)

- Quality improvement is based on cultural change in an organisation towards total quality management.

- Quality management through cultural change defines quality improvements as cultural change driven by management.

- It involves

① Identifying areas in which quality can be improved depending upon process capability measurements and organisational priorities.

② An organisation must setup crossfunctional working groups and try to improve awareness about the customer needs, quality and process measurments.

③ Instituting teams representing diffn functions & areas for quality improvement can help in setting the change of culture.

④ Improving quality of the processes of developmen testing, managing etc is team work lead by managing directives.

⑤ Setting measurable goals in each area of an organisation can help in improving processes at all levels.

⑥ Giving recognition to achievers of quality goals boost their morale and set a positive

competition among the team leading to organisati
-onal improvements.

⑦ Repeating quality improvement cycle contin-
-uously by stretching goals further for next phase of
improvements is required to maintain & improve
status further.

⑧ The organisation must evaulate the goals to
be achieved in short term, long term & combination
of both to realise organisational vision.

✳ Continual Improvement Cycle :- (Ref. Pag No 24)

Plan, Do, check and Act (PDCA) cycle :-
  - continual (continuous) improvement
cycle is based on systematic sequence of
Plan-Do-check activities representing a never
ending cycle of improvements.
    - PDCA cycle was initially implemented in
agriculture.
        - It was later implemented in electronic
industry.
        - TQM has made the PDCA cycle famous
in all industries.
        - Stages of continual improvement
through PDCA cycle are :-
  ① Plan /:-
        - An organisation must plan for improve
-ments on the basis of its vision & mission
defination.
        - planning includes answering all questions
like: who, when, where, why about various
activities & setting expectations.

② **Do :-**

- An organization must work in the direction set by the plan devised in earlier phase fof improvements.

 - plan is not everything but a roadmap.

 - It sets a direction but execution is also important.

 - plan sets the tone while execution makes the plan work.

③ **Check :-**

 An organisation must compare actual outcome of Do stage with reference or expected resuts which are planned.

④ **Act :-**

 If any deviations (positive or negative) are observed in actual outcome with respect to planned resuts the organisation may need to decide actions to correct situation.
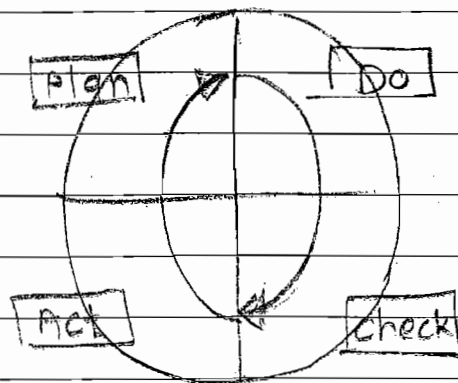

fig :- Continual Improvement cycle (PDCA cycle)

- When expected resuts and actual match with degree of variation, one may understand plan is going on in right direction. Running faster & slower plan need a action.

* Quality in Different areas :- (Ref. Page No 25)

    - Different domains need diff^n quality factors. They may be arrived from customers/users of the domain.

    - Defination of quality expectations will vary from instance to instance depending on the domain under consideration.

Products and expected attributes

Sr.No	Product/Service Category	Expected attributes
①	Airlines Industry	On time arrival & departure, comfortable journey, low cost service, reliability & saftey.
②	Health care Industry	Correct diagnosis and treatment, min wait for time, lower cost, saftey & security.
③	Food service Industry	Good product, good taste, fast delivery, good ambience, clean environment.
④	Consumer Products Industry	Properly made to suite individuals, defect free products, cost effective.
⑤	Miltary services	Rapid deployment, decreased wages & cost security
⑥	Automotive Industry	Defect free product, less fuel consumption, more power, safe journey.

communications :- clear communications, faster access, industry   cheaper service.

* Benchmarking and Metrics :- (Ref Pag No 26)

Benchmarking :-
    - It is an important concept used in Quality function deployment (QFD).
    - It is the concept of creating qualitative/ quantitative metrics of measurable variables which can be used to assess product quality on several scales against a benchmark.
    - Typical variables of benchmarking includes price of a product paid by customer, time require to acquire it, customer satisfaction, defects of product.

Metrics :-
    - Metrics are defined for collecting information about the product capabilites, process variability & outcome of the process in terms of the attributes of products.
    - metric is relative measurment of some parameter of a product which are related to the product & processes used to make it.
    - An organisation must develop consistent set of metrics derived from its strategic business plan and performance of benchmark partner.

* **Problem Solving Techniques :-**

- Improving quality of products and services offered to customers requires methods and the techniques of solving problems associated with development and processes used during their lifecycle.
- Problem solving can be accomplished by both qualitative and quantitative methods.

① **Qualitative problem Solving**

- It refers to understanding a problem soln using only qualitative indexes such as high, medium, low depending on whether something is improving from present status & so forth.
- This is typical scenario for low maturity organisations where the problems are much broader & can be classified in diffn bands very easily.
- It saves time in defining & measuring data accurately & basic maturity can be achieved.

② **Quantitative Problem solving**

- It requires specification of exact measures in numerical terms such as cost has increased 32.5% during the last quarter or the time required to produce one product unit is reduced by 32 minutes
- For highly matured organisations, quantitative analysis is required for further improvement on basic are already done.
- measurement of processes and products may need good measuring instruments with high level of accuracy & repeatability.

✳ Problem Solving Software Tools :- (Ref. page No 25)

  While buying software for data management and statistical analysis many organisations find it to be a big investment in terms of money. resource.

Advantages of Using Software Tools for Analysis & Decision making
 ① Accuracy and speed of the tools in much higher compared to performing all transactions calculations manually.
 ② Decision support offered by the tool is independent of personal skills & there is least variation from instance to instance.
 ③ Tools can implement theoretical means of assessing metrics about quality as defined by business law.

Disadvantages of using Computer tools for analysis & decision making
 ① Training incurs cost as well as time.
 ② All software / hardwares are prone for defects & these tools are not exceptions to it.
 ③ Decision has to be taken by human being and by the tool.
 ④ Tools may more cost & time to learn & implement

Tools :-
 - Tools of an organisations analytical asset in understanding a problem through data & try to indicate possible solutions.

-Quality tools are more specific tools which can be applied to solving problems faced by projects.

- Tools may be hardware/software & physical tools

Techniques :-

_ Techniques indicates about a process used in measurment, analysis & decision making during problem solving.

- Techniques are independent of tools but they drive tool usage.

Tools	Techniques
Usage of tools is guided by the technique.	Technique is independent of any tool.
Different techniques may use the same tool to achieve diffn results	Same technique use diffn tools to achieve the same result.
Tool improvement needs technological change.	Technique change can be effected through procedural change.
Contribution of tools in improvement is limited.	Contribution of techniques is improvement is important.

* Software Quality :- (Ref Page.No.30)

- Software quality is conformance to explictly
Stated and agreed functional & non-functional
requirements.

- It termed as quality for the software product
offered to customers/ final users from their
perspective.

- Customer may or may not be final user &
Sometimes, developers have to understand requirement
of final users in addition to customer.

- If the customer is a distributor or retailer
or facilator who is paying for product directly,
then the final user's requirements may be interprete
by the customer to make the right product.

Constraints of Software product quality assessment

- Generally requirement specifications are
made by the business analysts & system analysts.

- Tester may or may not have direct access to
the customer & may get information through
requirement statements, queries ans from either
Customer or business system / analysts. etc.

- There are few limitations of product
quality assesment in this scenario,

① Software is virtual in nature. Software
products can not be seen, touched or heard.

② There is a huge communication gap betn
users of software & testers of product.

③ Software is a product is unique in nature.
Similarities betn any two products are superfical
ones.

* <u>Customer is a king</u> :- (page No.31)   ref.

- The customer is the most important person in any process of developing a product and using it software development is not an exception.
- All software life cycle processes such as development, testing, maintenance etc are governed by customer requirements, whether implied or expressed.
- An organisation must be dedicated to exceed customer satisfaction with the latter's consent.
- <u>Exceeding customer satisfaction must not be received with surprise by the customer.</u>
- A satisfied customer is an important achievement for an organisation and is considered as an invesment which may pay back in short & long term.
- Satisfied customers may give references to others & come back with repeat orders.
- Customer references are very important for developing new accounts.
- organisations should try to implement some of the following measures to achieve customer satisfaction.

① Internal customer & internal supplier
   It is guided by the principles of total quality management.

② External customer & external supplier
   External customers may be the final user purchasers of software.

* Quality and productivity relationship : (Ref.Pag No 34)

- Quality of a product can be achieved by more inspection or testing, reworking, scrapping, sorting

- more inspection cycles mean finding more defects mean better quality & ultimately the customer may get product.

- Quality improvement does not talk about product quality only but a process quality used for making such a product.

- If the processes of development & testing are good, a bad product will not be manfactured in the first place.

① Improvement in quality directly leads to improved productivity.

② The hidden factor producing scrap, rework, Sorting, repair & customer complaint is closed.

③ Effective way to improve productivity is to reduce scrap & rework by improving process

④ Qualit improvements leads to cost estimation

⑤ Emplyee involvement in quality improvement

⑥ Proper communication between management& employee is essential.

⑦ Employees participate & contribute in improvement process.

⑧ Employee shares responsibility for innovation& quality improvement.

㊙

* Requirements of a product :- (Ref. Page No 34)

- Everything done in software development, testing & maintenance is driven by the requirement of a product to satisfy customer needs.

- Requirements may be put in different categories.

① Stated / Implied requirements :

- Some requirements are specially documented in software requirement specifications while few others are implied ones.

- When we build software which will be there are functional & non-functional requirements specified by a customer / system analyst.

② General / Specific requirements :-

- Some requirements are generic in nature, which are generally accepted for a type of product & for a group of users while some other are very specific for the product under development.

③ Present / future Requirements :-

- Present requirements are essential when an application is used in present circumstances while future requirements are for future needs which may be required after some time span.

- for projects, present as well as future requirements may be specifically defined by a customer or business/ system analyst.

④ 'Must' and 'must not' Requirements or Primary Requirements :-

     - Must requirements are primary requirements for which the customer is going to pay for while acquiring a product.

     - These are essential requirements and the value of the product is defined on the basis of the accomplishment of 'must' requirements.

⑤ 'Should be' and 'should not be' Requirements or Secondary Requirements :-

     - Should be requirements are the requirements which may be appreciated by the customer if they are present/absent and may add some value to the product.

     - customer pay little bit extra for the satisfi-cation of these requirements but price of the product is not governed by them.

⑥ 'Could be' and 'could not be requirements or Tertiary Requirements :-

     - 'Could be' requirements are requirements which may add a competitive advantage to the product but may not add much value in terms of price paid by a customer.

     - If two products have everything same then could be requirements may help in better appreciation of a products by the users.

* **Organisation Culture :-** (Ref. Page No. 36)

- An organisation has a culture based on its philosophy for existence, management perception and employee involvement in defining future.

- Quality improvement programs are based on the ability of the organisation to bring about a change in culture.

- Quality culture of an organisation is an understanding of the organisations virtue about its people, customer, supplier and all stakeholders. 'Q' organisations are more quality conscious organisations while 'q' organisations are less quality conscious organisations.

- The difference between 'Q' organisation & 'q' organisation

	Quality culture is 'Q'	Quality culture is not 'q'
①	These organisations belive in listening to customers and determining their customers requirements	These organisations assume that they know customer requirements
②	These organisations conc-entrate on identifying cost of quality & focusing on it to reduce cost of failure which will reduce cost & price.	These organisations overlook cost of poor quality & hidden factor effect. They belive in more testing to improve product quality.

	Quality culture is 'Q'	Quality culture is not 'q'
③	Doing things right for the first time & every time is the motto of success ...	Doing things again & again to make them right is their way of working. Inspection, rework, scrap etc and essentia
④	These organisations belive in taking ownership of processes and defects at all levels.	These organisations try to assign responsibility of defects to someone else.
⑤	They demonstrate leadership & commitment to quality & customer satisfaction.	They belive in assigning responsibility for quality to others.

✱ Shift in focus from 'q' To 'Q'

   - As the organisation grows frow 'q' to 'Q' there is cultural change in attitude of the managemer and employees towards quality & customer.

   - In initial stage at the higher side of 'q' a product subjected to heavy inspection, rework, sorting, scrapping etc to ensure that no defects are present in final delierable to customer while final stage of 'Q' organisation concentrate on defect prevention through process improvents.

<center>Quality Control</center>
<center>↓</center>
<center>Quality Assurance</center>
<center>↓</center>
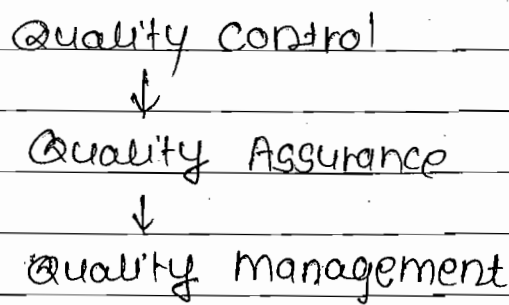<center>Quality Management</center>

<center>fig. shift in focus from quality control to quality management</center>

① Quality control approach is the oldest approach in engineering when a product was subjected to rigorous inspection for finding & fixing defects to improve it. Organisations at higher end of 'q' belive in finding and fixing defects to the extent possible as they improve quality of product.

② Quality assurance approach (creation of process framework) is the next stage of improvement from quality control where the focus shifts from testing and fixing the defects to first time right.

③ Quality management approach in there are three kinds of system in the universe, viz completely closed systems, completely open systems and systems with semipermeable boundaries. Completely closed system represent that nothing can enter inside the system and nothing can go out of the system.

* Characterstics of Software :- (Ref. Page No 38

① There are many products available in the market which are intended to satisfy same or similar demands.

② There is a vast difference between Software products & other products due to their nature.

① Software can not be sensed by common methods of inspection or testing. The product is in the form of executable which can not be checked by any natural method available to mankind like touch, smell, hearing, taste etc. It needs testing in real environment but nobody can do exhaustive testing by trying all permutations & combinations.

④ There are different kinds of software products & their performance, capabilities etc vary considerably from each other. There are no same products though there may be several similar ones or satisfying similar needs.

⑤ Every product is different in characterstics, performance etc. Software is alway unique in nature.

⑥ Every condition defined by the software program gets executed in the same way every tim when it gets executed. But the number of condition and algorithm combinations may be very large tending to infinity & testing of all permutation/ combinations in practically impossible .

* | Software Development Process :- (Ref Page No. 36)

- Software development process defines how the software is being built.

- Some people also refer to SDLC as system development life cycle with a view that system is made of several components & software is one of the components.

- They are various approaches to build software It may be positive & negative points.

① Waterfall development approach / model
② Iterative development approach / model
③ Incremental development approach / model
④ Spiral development approach / model
⑤ Prototyping development approach / model

⑥ Rapid application development approach / model

⑦ Agile development approach / model .

① <u>Waterfall Development Approach / Model</u>

    - It is simplest software development model and is used extensively in development process study .

    - It is also termed as classical view of software development as it remains as a primary focus for study purpose or funduation of any development activity .
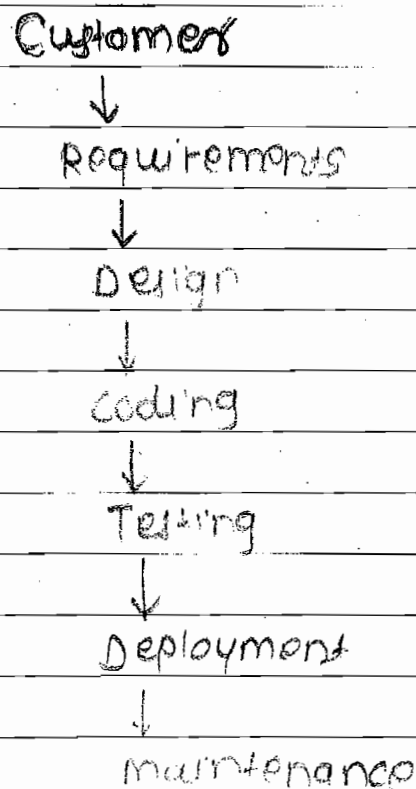
<div align="center">

Customer

↓

Requirements

↓

Design

↓

Coding

↓

Testing

↓

Deployment

↓

Maintenance

</div>

fig. Waterfall model

    - Arrows in the waterfall model are undirection

    - It assumes that developers shall get all requirements from customer in single go.

    - The requirements are converted into high

level as well as low level designs.
- Design are implemented through coding.
- Code is integrated & executables are created.
- Executables are tested are per test plan.
- The final output in the form of an executable is deployed at customer premises.
- Waterfall model are used extensively in fixed price / fixed schedule projects where estimation is based on initial requirements. As the requirement changes, estimation is also revised.

Limitations of Waterfall cycle :-
- There is no feedback loop available in waterfall model.
- It is assumed that requirements are stable and no problem is encountered during entire development life cycle.

② Iterative Development Approach / model
- Iterative development process is more practical than the waterfall model.

```
    ┌──→ Customer
    │        ↓
    ├──→ Requirements
    │        ↓
    ├──→ Coding Design
    │        ↓
    ├──→ Coding
    │        ↓
    ├──→ Testing
    │        ↓
    │     Deployment
    │        ↓
    └──→ Maintenance
```
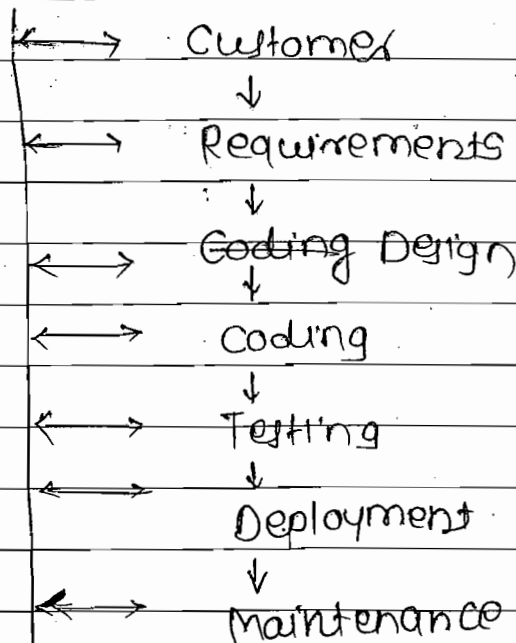fig. Iterative development model

- It does not assumes that the customer gives all requirements in one go & there is complete stability of requirements.

- It assumes that changes may come from any phase of development to any previous phase.

Limitations of Iterative Development :-

- Iterative development consist of many cycles of waterfall model.

- It gives problems in fixed price projects for estimation.

③ Incremental Development Approach/Model :-

- It is used in developing huge systems.

- There are made of several subsystems which in themselves are individual systems.

- Incremental systems may be considered as a collection of several subsystemy.

- These systems may be connected to each other externally either directly or indirectly.
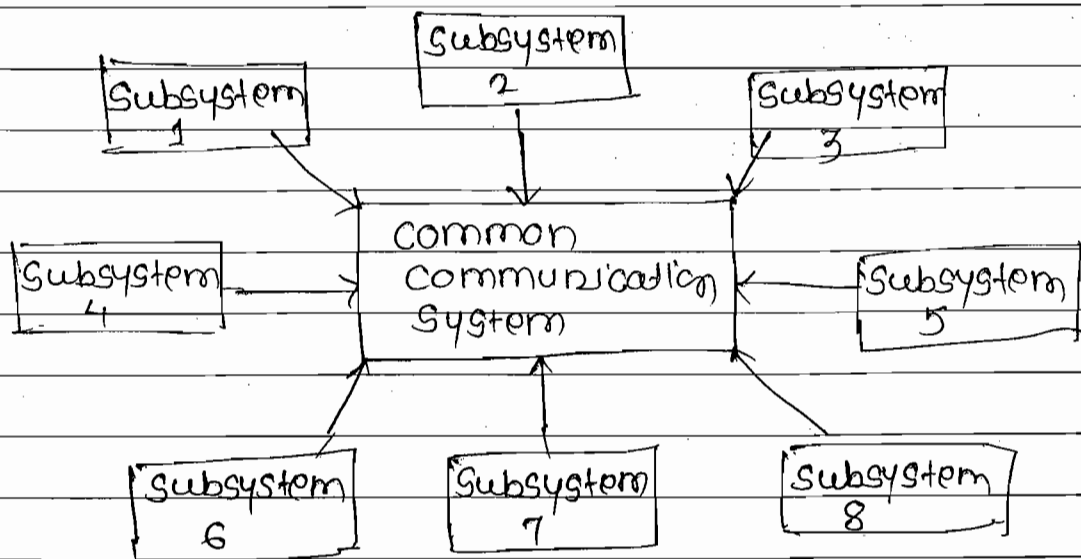

fig. Incremental Model

The incremental model gives flexibility to a customer.

Limitations of Incremental Development :-

- Incremental models with multivendor product integration are a major challenge as parameter passing between different systems may be difficult.

- Incremental models help in integration of big systems at the cost of loss of flexibility.

- When a system is incremented with new subsystems, it changes the architecture of that system.

(4) **Spiral Development Approach / model :-**

- Spiral development process assumes that customer requirements are obtained in multiple iterations & development also work in iterations.

- Many big software systems are built by spiral models of ever-increasing size.

- First some functionalities are added then product is created & released to customer.

- After getting the benefits of first iteration of implementation the customer may add another chunk of requirements to the existing one.

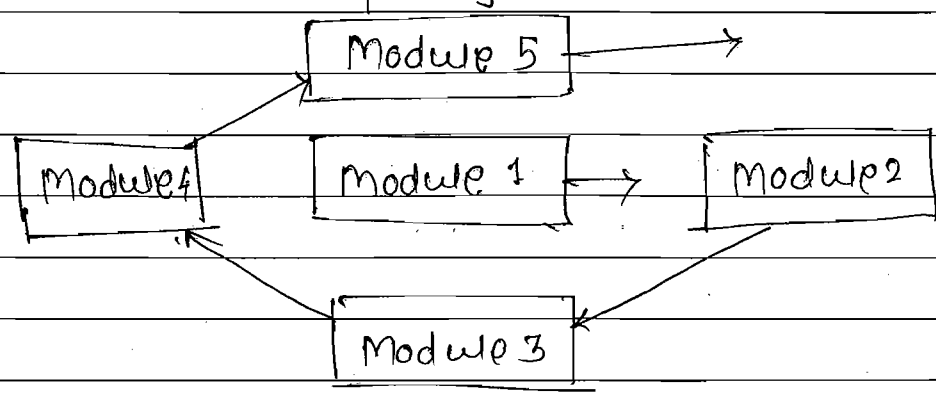- Further addition of requirements increase the size of software quality.

```
                    ┌──────────┐
                    │ Module 5 ├──────────→
                    └──────────┘
                       ↗
   ┌─────────┐   ┌──────────┐      ┌──────────┐
   │ Module4 │   │ Module 1 ├────→ │ Module 2 │
   └─────────┘   └──────────┘      └──────────┘
        ↖                             ↙
            ┌──────────┐
            │ Module 3 │
            └──────────┘
```

fig. Spiral development model.

-Spiral development is considered as a miniature form of the incremental model.

Limitations of Spiral Development :-
 -Spiral models represent requirement eliction as the software is being developed.
 - Sometimes it may lead to refactoring & change in approach where initial structure become non-usuable.

(5) Prototype Development Approach/model :-
 - Prototype development approch represents top to bottom reverse integration approach.
 - major problem of software development is procurring and understanding the customers requirem for the product.
 - protyping is one of the solution to help them
 - In prototyping initially a prototype of the system is created, this is similar to cardboard model of building.
 - It helps the customer to understand what they can expect from the given set of requirements
 - It also helps the development team to understan the possible applications look & feel.
 - Once the election is done the logic is build behind it to implement the elicited requirements.

Limitations of Prototype Development :-
 - Though one may get the feel of system by looking at the prototype one must understand that it is not actual system but a model.
 - The customer may get the feeling that the system is already ready & may deliver it immediately

* <u>Types of product :-</u>   (Ref. Page No 43)

    - Software development methodologies software products have some peculiarities defined as criticalities of software.

    - criticality of the software defines how much important it is to a user / customer.

    - There are few schemes of grouping the products on the basis of criticality to the user few of them are

① <u>Life Affecting products :-</u>
    - products which directly / indirectly affect human life considered as most critical products in the world from user's perspective.

    - such products generally come under the purview of regulatory & safety requirements ·

    - This type of product may be further grouped into <u>5</u> diffⁿ categories .

    ⓘ Any product failure resulting into death of person. These will be most critical products as they can affect human life directly .

    ⓘ <u>Any</u> product failure which may cause permane disablement to a patient. These are second level criticality products ·

    ⑰ <u>Any</u> product failure which may cause temporary disablement to a patient.

    Ⓥ Any product failure which may cause minior injury & does not result into anything .

    ⓥ other products which do not affect health of saftey directly ·

② Product Affecting Huge sume of money

- A product which has direct relationship with loss of huge sum of money is second in the list of criticality of the product.

- Such products may need large testing efforts & have many regulatory & stationary requirements.

- ecommerce & eBusiness softwares may be put in this category.

- Security, confidentiality & accuracy are some of the important quality factor for such large products.

③ Products which can be tested only by simulators :-

- Products which can't be tested in real life scenario but need simulated environment for testing are third in the ranking of criticality.

- Products used in aeronautics, space research etc may be put in this category.

- Such products also need huge testing, although lesser than earlier two types.

④ Other Products :-

- Unfortunately 'criticality' is not very easy to define.

- Let us consider an example of auto piloting software where we have three combinations of criticality together.

- It does not affect the life of passenger travelling cost of an aeroplane is huge & it can't be tested in real environment.

- These all three criticalities coming together make a product most critical.

※ Criticality Definitions :- (Ref. Page No 45)

- There may be several other ways of classifying criticality of a product.
- It has direct relationship with business dependab- ility & extent of loss to the user organisation/ person in case of failure.

① From user's perspective :-
- This classification mainly discuss dependency of a business on a system.
- Product's failure which distrupts the entire business can be very critical from business point of view.
- Product's failure which affects business partially as there may be some fallback arrangement is a type of criticality.
- Product's failure which does not affect business at all is one of the options. If it fails one may have another method to achieve same result.

② Another way of defining user's perspective :-
- The classification considers the environment in which the product is operating.
- It may range from very complex enviroment to very easy user environment.
- products where user environment is very complex such as aeronautics it may be considered as critical.
- Products where user environment is comparatively less complex may represent the second stage of complexacity.

③ **Criticality from developer's perspective :-**

- This classification defines the complexcity of the System on the basis of development capabilities required.

- From based software where user inputs are taken & stored in some database.

• An & when required those inputs are manipulated & shown to user on screen or in the form of product.

- Algorithm based software where huge calculation are involved & decisions are taken or prompted by the system on the basis of outcome of these calculations.

* **Problematic Areas of Software Development Life Cycle :- (Ref. page No 45)**

① **Problems with Requirement phase :-**

- Requirement gathering & elicitation is the most important phase in software development life cycle.

- Many surveys indicate that the requirement phase introduces maximum defects in the product.

- Problems associated with gathering are

i) Requirement are not easily communicated

- Communication major problem in requirement statement creation, software development & implementation.

- The types of requirements are technical requirements, economical requirements, legal requireme operational requirements, system requirements -

(11) Requirements change very frequently :-
  - Requirements are very dynamic in nature
  - There are many complaints by development
teams that requirement change is very frequent.
  - Many times developer get confused because
customer requirements change frequently.

(2) Generally a unique product is developed at
    each time
  ,   - The same implementation done by two diff)
developers may differ from each other. thus a software
produced may be unique for that istance.

(3) Intangible nature of a product, intellectual approach
    throughout development
        - Software products can not be felt by normal
senses. It exastense can be felt by disc space it
occupies.

(4) Inspection can be exhaustive / impossible :-
        - While defineing exhaustive inspection one
may tend to include infinite permutations & combin-
-ations of testing. Testing of complete software
product is impossible.

(5) Effect of bad quality is not known immediately:-
        - Quality of software product can not be
improved by testing it again & again & finding &
fixing the defects. It needs to be built in the
product while development using good processes &
methods.

⑥ Quality is inbuilt in product :-

. Quality of a software product can not be improved by testing it again & again & finding & fixing the defects.

- It needs to be built in the product while development using good processes & methods.

⑦ Quality objectives vary from product to product/ customer to customer :-

- Quality objectives define the expectations of customer/user and the acceptance level of various parameters which must be present in a given product for accepting / using it.

- Quality objectives are product dependent, time dependent & are mainly driven by customers or final users.

* <u>Software Quality Management</u> :- (Ref. Page No. 50)

- Quality management approaches talk about managing quality of a product or service using systematic ways and methods of development & maintenance.

- It is much above achieving quality factors as defined in software requirement specifications.

- Quality management involves management of all inputs & processing to the processes defined as so that the output from the process is as per defined quality criteria.

- There are three levels of handling problems,

① Correction :-
- Correction talks about the condition where defects found in the product or service are immediately sorted & fixed
- This is natural phenomenon which occurs when a tester defines any problem found during testing.
- Many organisationations stop at fixing the defect through it may be defined by corrective action by them.
- This is mainly a quality control.

② Corrective Actions :-
- Every defect needs an analysis to find the root causes for introduction of a defect in the system
- Corrective action identification & implementation is a responsibility of operations management group.
- This is a quality assurance approach where process related problems are found & resolved to avoid recurrence of similar problems again & again.

③ Preventive Actions :-
- On the basis of root cause of the problem other potential weak areas are identified.
- Preventive actions means that there are potential weak areas where defect has not been found till that point but there are potential weak areas weak defect has not been found till that point but there exists a probability of finding the defect This is a quality management approach where an organisation takes preventive action so that there is

* <u>Why Software has Defects?</u> (Ref. page No. 50.)

 - One very important question about a product is 'Why there are defects in the product at all?'.

 - There is no single answer to this question.

 - After taking so much precaution of defining and implementing the processes doing verification & validation of each artifact during SDLC, Yet nobody can claim that the product is free of any defects.

 - In case of software development and usage, there are many factors responsible for its success failure. Few of them are

 ① There are huge communication losses beth different entities as requirements get converted into the actual product. Understanding of require-ments is a major issue & majority of the defects can be attributed to this.

 ② Development people are more confident about their technical capabilities & do not consider that they can make mistakes. Sometimes self review & or peer review does not yield any defects.

 ③ Requirement changes are very dynamic. As the traceability matrix is not available impact analysis of changing requirements becomes heuristic.

 ④ Technologies are responsible for introducing few defects. There are many defects introduced due to browsers, platforms, databases. etc.

 ⑤ Customer may not be aware of all requirements and idea develop of the product is used. Prototyping is used for clarifying requirements to overcome this

* **Processes Related To Software Quality :** (Ref Pag No 51)

- Quality environment is an organisation is established by the management.

- Quality management is a temple built by pillars of quality.

- Culture of an organisation lays the foundation for quality temple.

- Every organisation has diff^n number of tiers of quality management system defination.
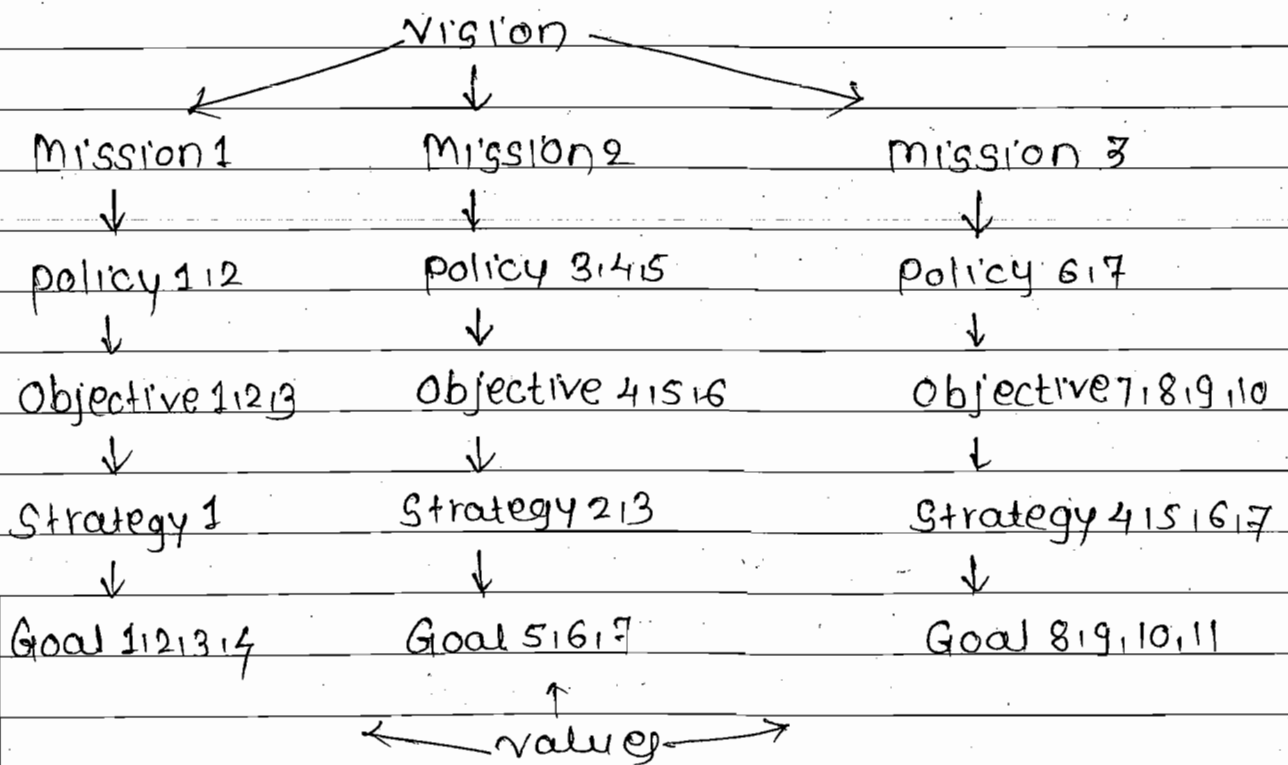
```
                        Vision
              ↙           ↓           ↘
   Mission 1        Mission 2         mission 3
      ↓                ↓                  ↓
   Policy 1,2       Policy 3,4,5      Policy 6,7
      ↓                ↓                  ↓
   Objective 1,2,3   Objective 4,5,6  Objective 7,8,9,10
      ↓                ↓                  ↓
   Strategy 1        Strategy 2,3     Strategy 4,5,6,7
      ↓                ↓                  ↓
   Goal 1,2,3,4     Goal 5,6,7        Goal 8,9,10,11
                        ↑
              ←——— values ———→
```

fig. Relationship bet^n vision, mission (s), policy (res), objective (s), strategy (es), Goal(s) & values. of organisation.

① Vision :-

-The vision of an organisation is established by the policy management. Vision defines in brief about what the organisation wishes to achieve in the given time horizon. Every organisation must have a vision statement, clearly defining the ultimate aim it wishes to achieve with respect to time span.

② Mission :-

In an organisation there are several initiatives defined as missions which will eventually help the organisation realise its vision.

③ Policy :-

Policy statements talks about a way of doing business as defined by senior management. There may be several policies to achiev mission. eg. security policy, quality policy & human resource development policy.

④ Objectives :-

Strategy defines the way of achieving a particular mission. It talks about the actions required to realise the mission & way of doing things.

⑤ Goals :-

Goals define the milestones to be achieved to make the mission successful.

⑥ Values :-

Values can be defined as the principles/way of doing business as perceived by the management.

* <u>Quality management System Structure :</u> (Ref Page N° 52)

- Every organisation has a different quality management Structure depending upon it's need & Circumstances. Generic view of quality management is
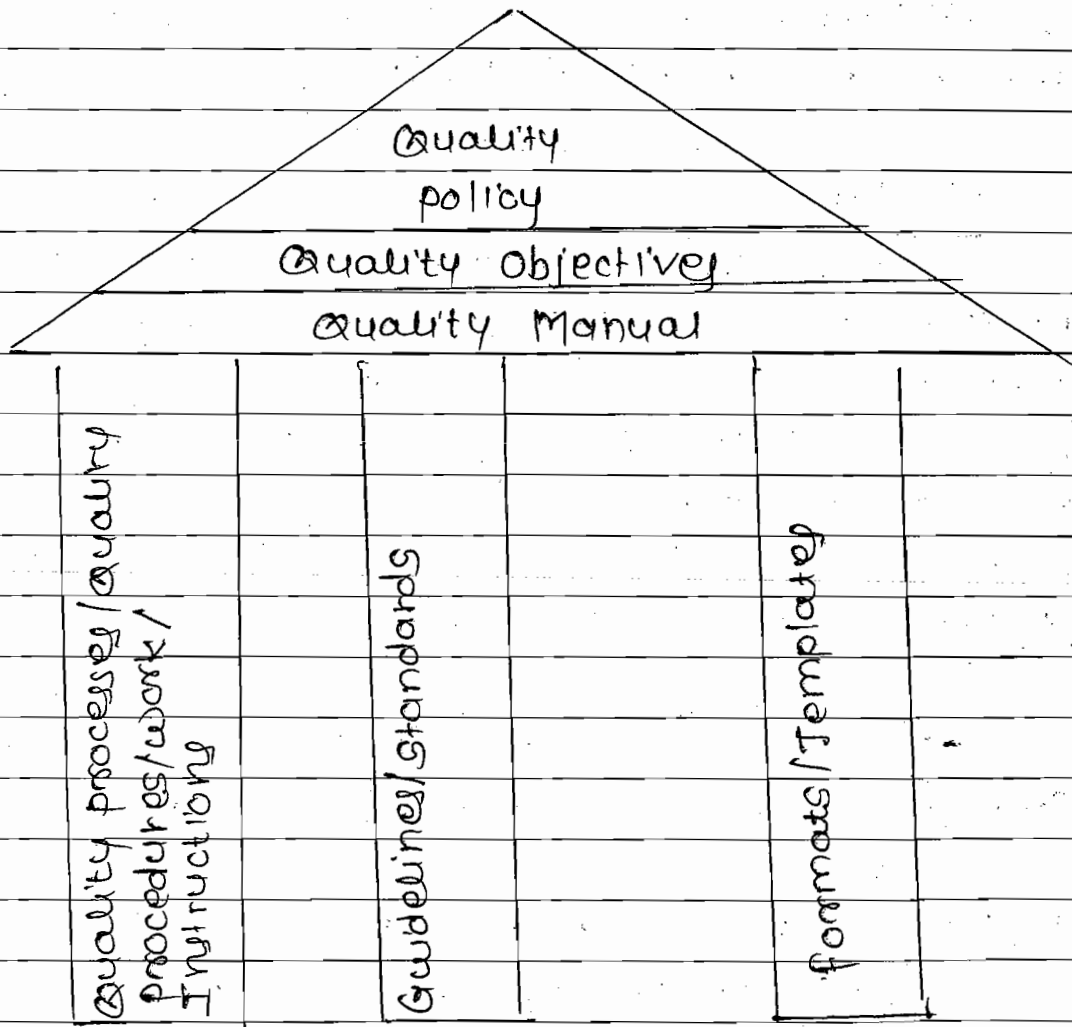

fig. Quality management System of a typical organisation.

(i) <u>1st Tier - Quality policy</u>

- Quality policy sets the wish, intent & direction by the management about how activities will be conducted by the organisation. Since management is the Strongest driving force in an organisation, it's items are most imp. It is a basic framework on which quality term resets.

(ii) **2nd Tier - Quality Objectives :-**

- Quality objectives are the measurments establised by the management to define progress & achievements in a numerical way. An improvement in quality must be demonstrated by improvement in achievements of quality factors in numerical termed as a expected by the management.

(iii) **3rd Tier - Quality Manual :-**

- Quality manual also termed as policy manual is established & published by the management of the organisation. It sets a framework for other process definations & is a foundation of quality planning at organisation level.

* Pillars of Quality Management System. (Ref Page No 53)

- Top part of the quality temple is build upon the foundation of following parts of pillars.

① **Quality process/ quality procedures/work instructions**

- Quality processes, quality procedures, work instructions methods are defined at an organisation level by the functional area, experts and as project and functional level by the experts in thase areas seperately.

- Organisation level processes act as an umbrella where as project & function level processes are in the purview of top level of organisations.

- Quality procedures must be in sync with tone established by quality manual at organisation level.

② Guidelines & Standards.

- Guidelines & standards are used by an organisation's project team for achieving quality goals for the products & services deliverd to customers.

- Many times guidelines defined by customers are termed as standards for the project as the project team takes the recommendations by customers as mandatory.

③ Formats and Templates :-

- Common formats & templates are used for tracking a project, function & department information within an organisation.

- It creates same understanding across the board where outputs can be compared for the projects & functions.

- Generally templates are mandatory while formats are suggestive in nature.

※ Important Aspects of Quality Management :-(Ref Page No 54)

- Quality improvement is not an accident but a planned activity.

- An organisation must plan for improvement under the leadership of management & with employee participation

① Quality planning at organisation level

An organisation creates quality plan at the organisation level for achieving quality objectives, goals & vision & mission.

(ii) Quality planning at project level.
(iii) Resource managements
(iv) Work Environment.
(v) Customer Related Processes
(vi) Quality management system document & data control.
(vii) Verification & validation
(viii) Software project management
(viii) Software configuration management.
(x) Software metrix & measurment
(xi) Sofware quality audits
(xii) Subcontract management
(xiii) Information security management
(xv) management review.

✳ Books :-

TextBook :-
① M. G. Limaye "Software Testing Principles, Techniques and Tools", Tata mcgraw Hill, ISBN: 9780701399090070139903

Unit No : 1

*	Introduction

Questions :-

① Explain 'quality' in terms of generic expectation from any product?

② Difference between continuous improvement and continual improvement.

③ Explain customer view of quality.

④ Explain supplier view of quality.

⑤ Explain various definitions of quality as per international standards.

⑥ Describe 'Total Quality Management'

⑦ Describe quality management through statistical process control.

⑧ Describe cultural change requirement for quality improvement.

⑨ Differentiate between tools and techniques.

⑩ What are constraints of software requirement specifications?

⑪ Explain relationship between quality & productivity.

⑫ Explain concept of 'q' organisations & 'Q' organisations

⑬ Explain different development models.

⑭ How products are classified depending upon their criticality?

⑮ What are different types of requirements.

⑯ What problems are posed by requirement stages?

⑰ What are characterstics of good requirements?

⑱ Explain difference between present and future requirements.

⑲ Explain difference between generic and specific requirements

(20) 20 Explain generic quality management system
Structure for an organisation.

(21) Explain the pillars of quality management
System.