# Quality Assurance

# QA

- **Quality assurance** (**QA**) refers to the planned and systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled.
- It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention. This can be contrasted with Quality "Control". which is focused on process outputs.

# QA

- in QA are: "Fit for purpose", the product should be suitable for the intended purpose; and "Right first time", mistakes should be eliminated.
- QA includes management of the quality of raw materials, assemblies, products and components, services related to production, and management, production and inspection processes.

# Testing methods

- 1.1 The box approach
  - White-box testing
  - Black-box testing
  - Grey-box testing
  - Visual testing

# Why QA

- To counter bad workmanship, full time inspectors were introduced to identify, quarantine and ideally correct product quality failures.
- cost of scrap and rework.
- an improved form of quality control known as Statistical Quality Control, or SQC was introduced for mass production.

# Testing levels

- 2.1 Test target
  - Unit testing
  - Integration testing
  - System testing
  - System integration testing
- 2.2 Objectives of testing
  - Regression testing
  - Acceptance testing
  - Alpha testing
  - Beta testing

# Alpha- Beta

- Alpha testing is the testing conducted by the customer at development environment to check whether the product being developed is matching the requirements.

  Beta testing is the testing conducted by the end user to check whether the product behavior in customer environment is similar to its behavior in test environment.

# Non-functional testing

- Software performance testing
- Usability testing
- Security testing
- Internationalization and localization
- Destructive testing

# The testing process

- Traditional CMMI or waterfall development model
- Agile or Extreme development model

# waterfall model

- The **waterfall model** is a sequential design process, often used in software development processes, in which progress is seen as flowing steadily downwards (like a waterfall) through the phases of Conception, Initiation, Analysis, Design, Construction, Testing, Production/Implementation, and Maintenance.
- The waterfall development model originates in the manufacturing and construction industries.

# Agile software development

**Agile software development** is a group of software development methods based on iterative and incremental development, where requirements and solutions evolve through collaboration between self-organizing, cross-functional teams.

By optimizing the return on investment (ROI) Agile methods lie on the *adaptive* side of this continuum. Adaptive methods focus on adapting quickly to changing realities.

# Automated testing

- Testing tools
- Measurement in software testing

# SQC

- every production piece cannot be fully inspected into acceptable and non acceptable batches.
- inspectors with control tools such as sampling and control charts, even where 100 per cent inspection is not practicable.
- Standard statistical techniques allow the producer to sample and test a certain proportion of the products for quality to achieve the desired level of confidence in the quality of the entire batch or production run.

# Six sigma

- Many organizations use statistical process control to bring the organization to Six Sigma levels of quality.
- unexpected failure is confined to six standard deviations on the normal distribution. This probability is less than four one-millionths.

# ISO

- ISO 17025 is an international standard that specifies the general requirements for the competence to carry out tests and or calibrations.
- There are 15 management requirements and 10 technical requirements. These requirements outline what a laboratory must do to become accredited.

# QA in non-business activity

QA is not limited to the manufacturing, and can be applied to any business :

- Design work
- Administrative services
- Consulting
- Banking
- Insurance
- Computer software development
- Retailing
- Transportation
- Education
- Translation

# Inspection

# Inspection

**Inspection :**

Inspection means checking dimensions of what has been produced or being produced, and determining whether it complies with the specified dimensional accuracy.

Two types of Inspection are :

1. **Post-process Inspection:**

   Measurements are made after the part has been produced.

2. **In-process Inspection:**

   - Measurements are made while the part is being produced on machine or during process.
   - Also termed as on-line or real time Inspection.

# Factors in selecting Inspection Equipment

1. **Gage capability :**
   - Measurement device should be ten times more precise than the tolerance to be measured [ Known on Factory as ‘Rule of 10’].
2. **Linearity :**

   Refers to calibration accuracy of the device over its full working range.
3. **Repeat Accuracy :**

   How repeatable is the device is taking the same reading once and over a given reference standard?
4. **Stability:**
   - Retention of calibration of device over a period of time. Stability is also called drift.
   - As devices become more accurate, they lose stability and become more sensitive to small changes in temperature and humidity.

**5. Magnification:**

- Amplification of output portion of device over actual input dimension .
- More accurate a device, the greater must be its magnification factor so that required measurement can be read out (or observed) and compared with the desired standard.

**6. Resolution (or Sensitivity):**

- Refers to the smallest unit of scale on dimensional input that device can detect or distinguish.
- Greater the resolution of device, smaller things it can resolve and greater will be magnification required to expand the measurements upto a point that can be observed by naked eye.

# Note :

Other factors of importance in selecting Inspection device are:

- Geometry of Workpiece
- Type of measurement information desired.
- Range of sizes device can handle versus size and geometry of Workpiece.
- Environment
- Cost of device and cost of installing and using the device (Depends on speed of measurement, degree to which it can be automated and functional life of device in service)

# Basic kinds of Inspection Methods

| Method | Typical Accuracy | Major Applications | Comments |
|---|---|---|---|
| Air | 0.5-10 µin<br>(2 to 3% of Scale Range) | ▪ Gaging holes and shafts using calibrated difference in air pressure or air flow with magnification of 20,000-40,000 to 1.<br>▪ Used for machine control , sorting and classifying. | High precision and flexibility; can measure out of round, taper, concentricity, clearance between mating parts . |
| Optical Light Energy | ▪ 0.2 - 2 µin or better with Laser Interferometry<br>▪ 0.5 – 1 second of arc in Auto collimation Optical Collimator | ▪ Interferometry, Checking flatness and size of GageBlocks, Flatness of surface plates, Accuracy of rotary Index Tables. | ▪ Auto Collimator used for making precision angular measurements<br>▪ Laser used for precision in-process measurements. |

| | | | |
|---|---|---|---|
| Optical Electron Energy | 100 Aº | ▪ Precision measurements in Scanning Electron Microscopes of microelectronic circuits and other precision small parts . | ▪ Parts size restricted by Vac. Chamber size.<br>▪ Electron beam used for processing and part testing of electronic circuits. |
| Electronics | ▪ 0.5 - 10 µin | ▪ Widely used for machine control, on-line inspection, sorting & classification, ODs, IDs, Height, surface & geometrical relationships.<br>▪ Most devices are comparators with movement of stylus or spindle producing an electronic signal that is amplified electronically.<br>▪ Commonly connected to microprocessors and minicomputers for process adjustment. | |

| | | | |
|---|---|---|---|
| Mechanical | 1.0 - 10 µin | External and Internal measurements using Dial indicators, Micrometers, Calipers etc. | Highly dependent on Worker’s skills |
| | | | |

# Inspection

- 1. Workplace is clean and orderly.
- 2. Floors are clear and aisles, hallways, and exits are unobstructed
- 3. Floor surfaces are kept dry and free of slip hazards..
- 4. Stairways, sidewalks, and ramps are free of defects (e.g. damaged treads, frayed carpet)
- 5. Illumination is adequate in all common areas and workstations.
- 6. Emergency evacuation plans are posted at every stairway and elevator landing, and immediately inside all public entrances to the building.
- 7. All containers, including non-hazardous chemicals and wastes, are labeled with the full chemical or trade name. (For storage of hazardous chemicals, please see note below.)

# Inspection

- 8. Stored materials are secure & limited in height to prevent collapse.

- 9. 36” clearance maintained for electrical panels.
- 10. Electrical cords and plugs are in good condition with proper grounding.

- 11. Extension cords and power strips are not daisy chained and no permanent extension cords in use.
- 12. Portable electric heaters have at least 3 ft of clearance from combustible materials (e.g. paper).
- 13. Equipment and machines are clean and working properly.
- 14. Adequate ventilation is provided to machines for preventing buildup of heat or gas emissions.
- 15. Emergency stop switches on machines are identified and in proper working order.
- 16. Mechanical safeguards are in place and in proper working order (e.g. paper cutter guards).

# QUALITY ASSURANCE in Railways POH Workshop

- All coaches and wagons undergoing POH in workshop are offered for inspection to Neutral Train Examiner.
- There has been no case of local passing of any coach or wagon from workshop.
- Cases of sick marking of coaches within 100 days are critically examined to take necessary remedial measures.
- Mandatory check up by NTXR

# Inspection(fire)

- 1. Emergency exit signs are lit properly.
- 2. Fire alarms and fire extinguishers are visible and accessible.
- 3. Fire doors (e.g. in stairways) are kept closed unless equipped with automatic closing device.

- 4. 18" vertical clearance is maintained below all sprinkler heads.
- 5. Fire extinguishers are serviced annually.
- 6. Corridors and stairways are kept free of obstruction and not used for storage.

# Inspection (Earthquake)

- 1. Bookcases, filing cabinets, shelves, racks, cages, storage cabinets and similar items over four feet tall are anchored to the wall.
- 2. Shelves have lips or other seismic restraints.
- 3. Portable machines or equipment secured against movement using chains, lockable casters, or other appropriate means.
- 4. Top-heavy equipment is bolted down or secured to wall studs to withstand accelerations typically expected in an earthquake.
- 5. Large & heavy objects are stored on lower shelves or storage areas.
- 6. Valuable equipment sensitive to shock damage, such as instruments, computer disks and glassware are stored in latched cabinets or otherwise secured to prevent falling.
- 7. Storage areas are uncluttered – providing clear evacuation routes in the event of an emergency.
- 8. Cabinets and lockers containing hazardous materials are equipped with positive latching or sliding doors.

# In-Process inspection

- The inspection of a part during production to detect errors. Errors that are detected early may allow the part to be reworked or prevented from continuing through the manufacturing process.
- **In-Process Inspection (IPI)** will take place during production between 20% and 80% of the manufacturing process.

# check during an In-Process Inspection

- Product appearance (AQL),
- workmanship quality,
- size measurements,
- weight check,
- functionality assortment, accessories, labeling & logos, packaging, packing and
- other tests and special requirements, depending on the product and the export market.

# IPI scope of work

- The In-Process Inspection (IPI) will also cover
- the raw materials,
- unfinished products and
- the planning of production.

# Working algorithm for IPI

- Inspectors chooses a specific quantity of completed products, according to AQL tables – and inspects them according to our specifications, requirements and according to our protocols and expertise.
- After completing the inspection, a fully detailed inspection report with pictures and comments is sent so that decision makers can Accept or Reject shipment.

# Value addition in IPI

- As production process are intervene in the middle of the production process, to check if the quality of in-process products reaches demanded standards according to targeted production schedule.
- Inspection of the actual production volume in-time evade any delays in final shipment by rework. At this stage, one can still modify the production protocol and still be on time with work order in case of problems.

# Usefulness of IPI

- It assure that the mass production quality is the same as the golden sample:
  - Implement the necessary corrective actions before having too many defects
  - Be aware of the percentage of defects of finished products
- The exact statement of the production planning:
  - Avoid unnecessary costs and delays

# Pre-Production Inspection

- **The Pre-Production Inspection (PPI)** is completed after identifying and evaluateing vendor / factory and is done right before the beginning of the actual mass production.
- It can be completed at the factory or at the vendor office.
- The goal of performing a PP Inspection is to make sure your vendor has understood your specific requirements and the specifications of your order and is actually prepared for its production.

# The Pre Shipment Inspection (PSI)

- The Pre Shipment Inspection (PSI), also called Final Random Inspection (FRI) or Finished Quality Control, will take place when at least 80% of the products are ready and packed into export cartons.
- consignee can of course specify when booking if they want 100% of the products to be ready for this inspection.
- The pre shipment inspection will take place at the factory, or in some cases, it could even take place at the forwarder’s premises or at the pier.

# Agencies for inspecting the materials purchased/ traded by IR.

- The Rate and Running contract items supplied by DGS&D are generally pre-inspected by its inspection wing before making supply i.e. Director of Inspection (DOI) or Director of Metallurgical Inspection (D.I.Met).
- Other than DGS&D items which are of complicated nature and which are required to be inspected at firm's works are generally inspected by RITES.
- Safety items which are under developmental stage and certain critical items have been identified for inspection of RDSO only.
- All other general stores which are regularly procured are subjected to consignee inspection. For all mechanical items inspection is done by Dy.CME/Inspection.
- If any chemical property or ultrasonic test is required samples are inspected by Dy.Chief Chemist and Metallurgist.
- Although items are pre-inspected by other inspection agencies, the same will be subjected to consignee inspection at ICF on receipt.

{{{The Consignee Inspection report will be final. }}}

# NTXR Officer inspection schedule

- NEUTRAL Train Examiner
- Role of inspection in maintenance task

# The Deming philosophy

14 points for management:

1. Create and publish to all employees a *statement of the aims and purposes* of the company. The management must demonstrate their commitment to this statement.
2. *Learn* the new philosophy.
3. Understand the *purpose of inspection* – to reduce the cost and improve the processes.
4. *End* the practice of awarding business on the *basis of price tag* alone.
5. *Improve constantly* and forever the system of production and service.

# The Deming philosophy

6. Institute training
7. Teach and institute *leadership*.
8. Drive out fear. Create an *environment of innovation*.
9. *Optimize the team efforts* towards the aims and purposes of the company.
10. Eliminate exhortations for the workforce.
11. Eliminate *numerical quotas* for production.
12. Remove the barriers that rob *pride of workmanship*.
13. Encourage *learning and self-improvement*.
14. Take action to accomplish the transformation.

# The Deming philosophy

- "A System of Profound Knowledge"

1. Appreciation for a system - A system is a set of functions or activities within an organization that work together to achieve organizational goals. Management's job is to *optimize the system*. (not parts of system, but the whole!). System requires *co-operation*.
2. Psychology – The designers and implementers of decisions are *people*. Hence understanding their psychology is important.

# The Deming philosophy

3. Understanding process variation – A production process contains many sources of variation. *Reduction in variation improves quality*. Two types of variations- *common causes and special causes*. Focus on the special causes. Common causes can be reduced only by change of technology.
4. Theory of knowledge – Management decisions should be driven by *facts, data and justifiable theories*. Don't follow the managements fads!

# The Juran philosophy

- Pursue quality on two levels:

1. The *mission of the firm* as a whole is to achieve high *product quality*.
2. The *mission of each individual department* is to achieve high *production quality*.

- Quality should be talked about in a language senior management understands: money (cost of poor quality).
- At operational level, focus should be on conformance to specifications through elimination of defects- use of statistical methods.

# The Juran philosophy

Quality Trilogy –

1. *Quality planning*: Process of preparing to meet quality goals. Involves understanding customer needs and developing product features.
2. *Quality control*: Process of meeting quality goals during operations. Control parameters. Measuring the deviation and taking action.
3. *Quality improvement*: Process for breaking through to unprecedented levels of performance. Identify areas of improvement and get the right people to bring about the change.

# The Crosby philosophy

## Absolute's of Management

- Quality means *conformance to requirements* not elegance.
- There is no such thing as *quality problem*.
- There is no such thing as economics of quality: it is always cheaper to do the *job right the first time*.
- The only performance measurement is the *cost of quality*: the cost of non-conformance.

## Basic Elements of Improvement

- *Determination* (commitment by the top management)
- *Education* (of the employees towards Zero Defects (ZD))
- *Implementation* (of the organizational processes towards ZD)

End