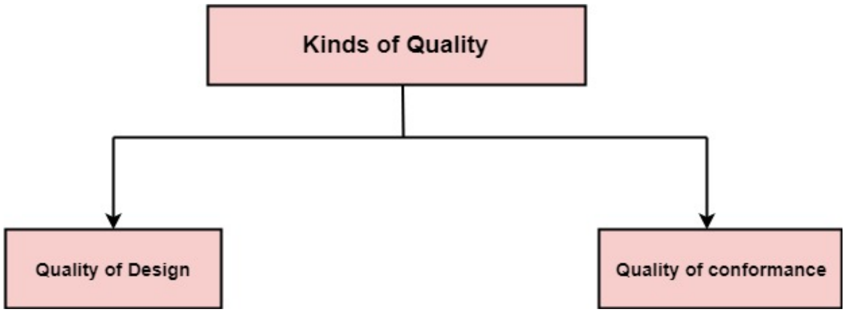
Software Quality Assurance

What is Quality?

Quality defines to any measurable characteristics such as correctness, maintainability, portability, testability, usability, reliability, efficiency, integrity, reusability, and interoperability.

There are two kinds of Quality:



Quality of Design: Quality of Design refers to the characteristics that designers specify for an item. The grade of materials, tolerances, and performance specifications that all contribute to the quality of design.

Quality of conformance: Quality of conformance is the degree to which the design specifications are followed during manufacturing. Greater the degree of conformance, the higher is the level of quality of conformance.

Software Quality: Software Quality is defined as the conformance to explicitly state functional and performance requirements, explicitly documented development standards, and inherent characteristics that are expected of all professionally developed software.

Quality Control: Quality Control involves a series of inspections, reviews, and tests used throughout the software process to ensure each work product meets the requirements place upon it. Quality control includes a feedback loop to the process that created the work product.

Quality Assurance: Quality Assurance is the preventive set of activities that provide greater confidence that the project will be completed successfully.

Quality Assurance focuses on how the engineering and management activity will be done?

As anyone is interested in the quality of the final product, it should be assured that we are building the right product.

It can be assured only when we do inspection & review of intermediate products, if there are any bugs, then it is debugged. This quality can be enhanced.

Importance of Quality

We would expect the quality to be a concern of all producers of goods and services. However, the distinctive characteristics of software and in particular its intangibility and complexity, make special demands.

Increasing criticality of software: The final customer or user is naturally concerned about the general quality of software, especially its reliability. This is increasing in the case as organizations become more dependent on their computer systems and software is used more and more in safety-critical areas. For example, to control aircraft.

The intangibility of software: This makes it challenging to know that a particular task in a project has been completed satisfactorily. The results of these tasks can be made tangible by demanding that the developers produce 'deliverables' that can be examined for quality.

Accumulating errors during software development: As computer system development is made up of several steps where the output from one level is input to the next, the errors in the earlier ?deliverables? will be added to those in the later stages leading to accumulated determinable effects. In general the later in a project that an error is found, the more expensive it will be to fix. In addition, because the number of errors in the system is unknown, the debugging phases of a project are particularly challenging to control.

Software Quality Assurance

Software quality assurance is a planned and systematic plan of all actions necessary to provide adequate confidence that an item or product conforms to establish technical requirements.

A set of activities designed to calculate the process by which the products are developed or manufactured.

SQA Encompasses

- A quality management approach
- Effective Software engineering technology (methods and tools)
- Formal technical reviews that are tested throughout the software process
- A multitier testing strategy
- Control of software documentation and the changes made to it.
- A procedure to ensure compliances with software development standards
- Measuring and reporting mechanisms.

SQA Activities

Software quality assurance is composed of a variety of functions associated with two different constituencies ? the software engineers who do technical work and an SQA group that has responsibility for quality assurance planning, record keeping, analysis, and reporting.

Following activities are performed by an independent SQA group:

1. **Prepares an SQA plan for a project:** The program is developed during project planning and is reviewed by all stakeholders. The plan governs quality assurance activities performed by the software engineering team and the SQA group. The plan identifies calculation to be performed, audits and reviews to be performed, standards that apply to the project, techniques for error reporting and tracking, documents to be produced by the SQA team, and amount of feedback provided to the software project team.
2. **Participates in the development of the project's software process description:** The software team selects a process for the work to be performed. The SQA group reviews the process description for compliance with organizational policy, internal software standards, externally imposed standards (e.g. ISO-9001), and other parts of the software project plan.
3. **Reviews software engineering activities to verify compliance with the defined software process:** The SQA group identifies, reports, and tracks deviations from the process and verifies that corrections have been made.
4. **Audits designated software work products to verify compliance with those defined as a part of the software process:** The SQA group reviews selected work products, identifies, documents and tracks deviations, verify that corrections have been made, and periodically reports the results of its work to the project manager.
5. **Ensures that deviations in software work and work products are documented and handled according to a documented procedure:** Deviations may be encountered in the project method, process description, applicable standards, or technical work products.
6. **Records any noncompliance and reports to senior management:** Non- compliance items are tracked until they are resolved.

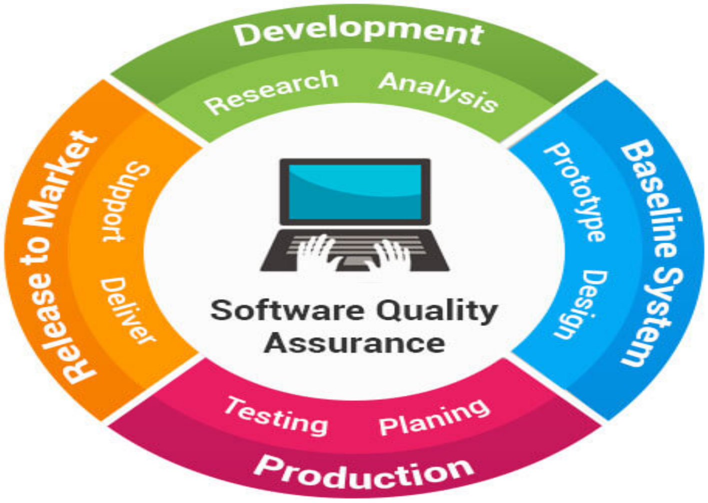
Quality Assurance v/s Quality control

Quality Assurance	Quality Control

Quality Assurance (QA) is the set of actions including facilitation, training, measurement, and analysis needed to provide adequate confidence that processes are established and continuously improved to produce products or services that conform to specifications and are fit for use.	**Quality Control (QC)** is described as the processes and methods used to compare product quality to requirements and applicable standards, and the actions are taken when a nonconformance is detected.
QA is an activity that establishes and calculates the processes that produce the product. If there is no process, there is no role for QA.	**QC** is an activity that demonstrates whether or not the product produced met standards.
QA helps establish process	**QC** relates to a particular product or service
QA sets up a measurement program to evaluate processes	**QC** verified whether particular attributes exist, or do not exist, in a explicit product or service.
QA identifies weakness in processes and improves them	**QC** identifies defects for the primary goals of correcting errors.
Quality Assurance is a managerial tool.	Quality Control is a corrective tool.
Verification is an example of QA.	Validation is an example of QC.

Software Quality Assurance Plan

Abbreviated as SQAP, the software quality assurance plan comprises the procedures, techniques, and tools that are employed to make sure that a product or service aligns with the requirements defined in the SRS(software requirement specification).



The plan identifies the SQA responsibilities of a team, and lists the areas that need to be reviewed and audited. It also identifies the SQA work products.

The SQA plan document consists of the below sections:

1. Purpose section
2. Reference section
3. Software configuration management section
4. Problem reporting and corrective action section
5. Tools, technologies, and methodologies section
6. Code control section
7. Records: Collection, maintenance, and retention section
8. Testing methodology

SQA Activities

Given below is the list of SQA activities:

#1) Creating an SQA Management Plan:

The foremost activity includes laying down a proper plan regarding how the SQA will be carried out in your project.

Along with what SQA approach you are going to follow, what engineering activities will be carried out, and it also includes ensuring that you have the right talent mix in your team.

#2) Setting the Checkpoints:

The SQA team sets up different checkpoints according to which it evaluates the quality of the project activities at each checkpoint/project stage. This ensures regular quality inspection and working as per the schedule.

#3) Apply software Engineering Techniques:

Applying some software engineering techniques aids a software designer in achieving high-quality specifications. For gathering information, a designer may use techniques such as interviews and FAST (Functional Analysis System Technique).

Later, based on the information gathered, the software designer can prepare the project estimation using techniques like WBS (work breakdown structure), SLOC (source line of codes), and FP(functional point) estimation.

#4) Executing Formal Technical Reviews:
An FTR is done to evaluate the quality and design of the prototype.

In this process, a meeting is conducted with the technical staff to discuss the actual quality requirements of the software and the design quality of the prototype. This activity helps in detecting errors in the early phase of SDLC and reduces rework effort in the later phases.

#5) Having a Multi-Testing Strategy:
By multi-testing strategy, we mean that one should not rely on any single testing approach, instead, multiple types of testing should be performed so that the software product can be tested well from all angles to ensure better quality.

#6) Enforcing Process Adherence:
This activity insists on the need for process adherence during the software development process. The development process should also stick to the defined procedures.

This activity is a blend of two sub-activities which are explained below in detail:
(i) Product Evaluation:
This activity confirms that the software product is meeting the requirements that were discovered in the project management plan. It ensures that the set standards for the project are followed correctly.

(ii) Process Monitoring:
This activity verifies if the correct steps were taken during software development. This is done by matching the actually taken steps against the documented steps.

#7) Controlling Change:
In this activity, we use a mix of manual procedures and automated tools to have a mechanism for change control.

By validating the change requests, evaluating the nature of change, and controlling the change effect, it is ensured that the software quality is maintained during the development and maintenance phases.

#8) Measure Change Impact:
If any defect is reported by the QA team, then the concerned team fixes the defect.

After this, the QA team should determine the impact of the change which is brought by this defect fix. They need to test not only if the change has fixed the defect, but also if the change is compatible with the whole project.

For this purpose, we use software quality metrics that allow managers and developers to observe the activities and proposed changes from the beginning till the end of SDLC and initiate corrective action wherever required.

#9) Performing SQA Audits:
The SQA audit inspects the entire actual SDLC process followed by comparing it against the established process.

It also checks whether whatever was reported by the team in the status reports was actually performed or not. This activity also exposes any non-compliance issues.

#10) Maintaining Records and Reports:
It is crucial to keep the necessary documentation related to SQA and share the required SQA information with the stakeholders. The test results, audit results, review reports, change requests documentation, etc. should be kept for future reference.

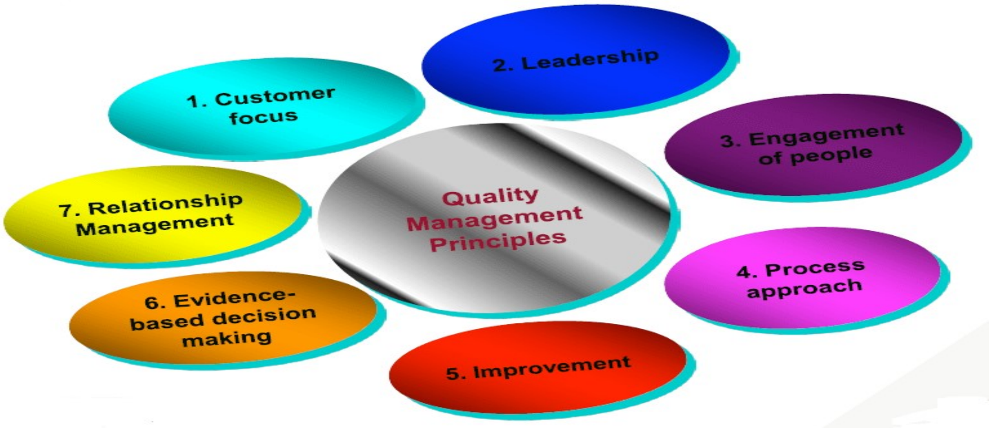
#11) Manage Good Relations:
In fact, it is very important to maintain harmony between the QA and the development team.

We often hear that testers and developers often feel superior to each other. This should be avoided as it can affect the overall project quality.

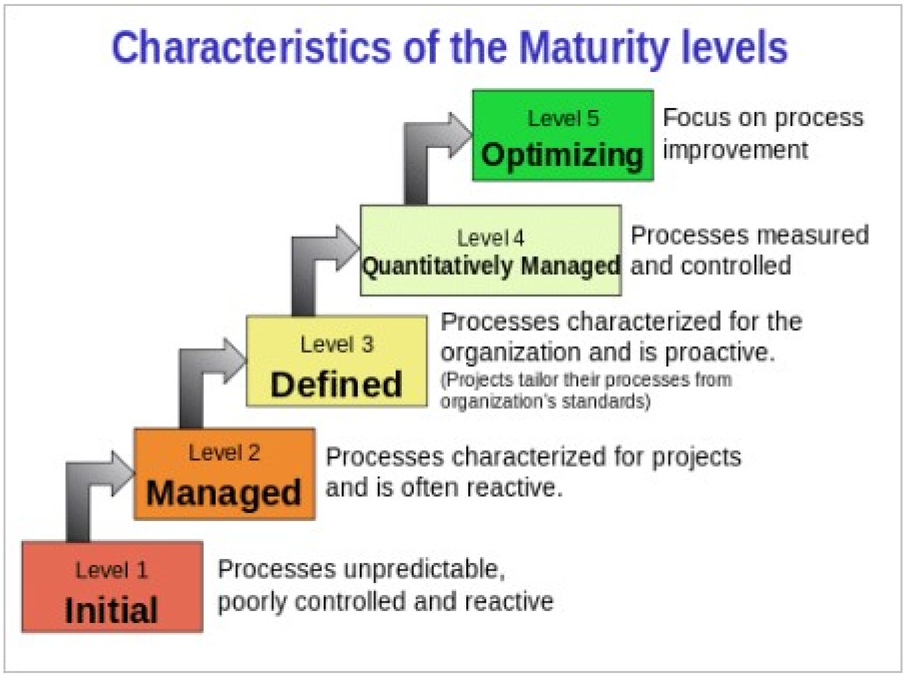
Software Quality Assurance Standards

In general, SQA may demand conformance to one or more standards.

Some of the most popular standards are discussed below:
ISO 9000: This standard is based on seven quality management principles which help the organizations to ensure that their products or services are aligned with the customer needs.
7 principles of ISO 9000 are depicted in the below image:


Quality Management Principles
1. Customer focus
2. Leadership
3. Engagement of people
4. Process approach
5. Improvement
6. Evidence-based decision making
7. Relationship Management

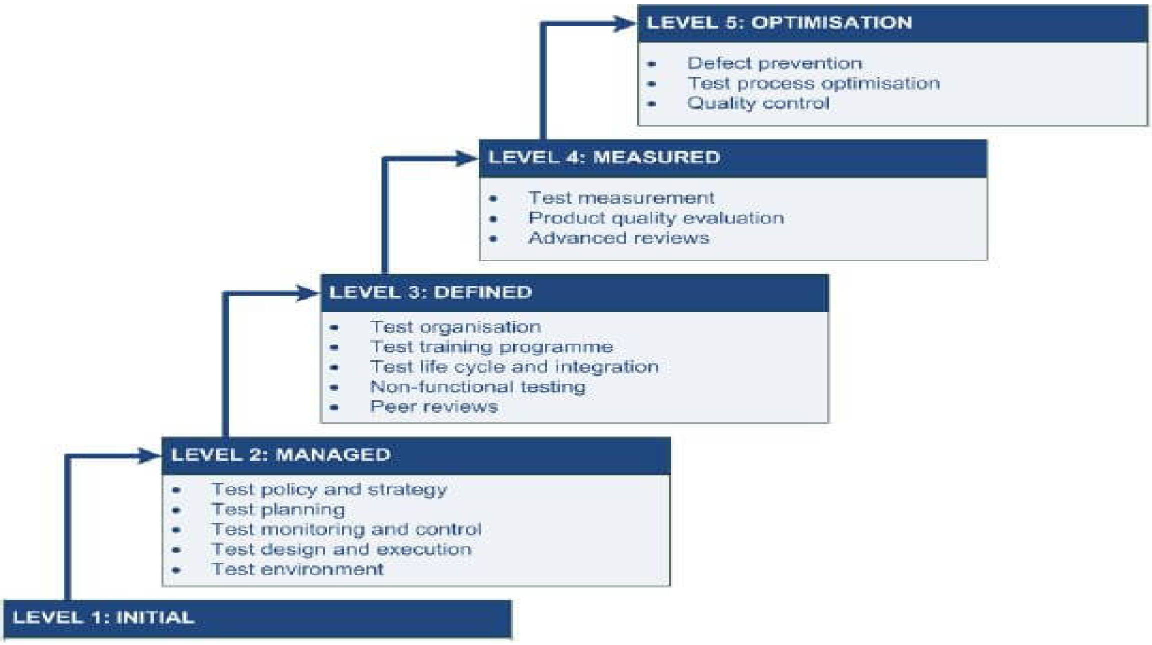
CMMI level: CMMI stands for **Capability maturity model Integration**. This model originated in software engineering. It can be employed to direct process improvement throughout a project, department, or entire organization.
5 CMMI levels and their characteristics are described in the below image:


Characteristics of the Maturity levels
Level 5
Optimizing
Focus on process improvement
Level 4
Quantitatively Managed
Processes measured and controlled
Level 3
Defined
Processes characterized for the organization and is proactive.
(Projects tailor their processes from organization's standards)
Level 2
Managed
Processes characterized for projects and is often reactive.
Level 1
Initial
Processes unpredictable, poorly controlled and reactive

An organization is appraised and awarded a maturity level rating (1-5) based on the type of appraisal.

Test Maturity Model integration (TMMi): Based on CMMi, this model focuses on maturity levels in software quality management and testing.

5 TMMi levels are depicted in the below image:



As an organization moves to a higher maturity level, it achieves a higher capability for producing high-quality products with fewer defects and closely meets the business requirements.

Elements of Software Quality Assurance

There are 10 essential elements of SQA which are enlisted below for your reference:

1. Software engineering Standards
2. Technical reviews and audits
3. Software Testing for quality control
4. Error collection and analysis
5. Change management
6. Educational programs
7. Vendor management
8. Security management
9. Safety
10. Risk management