



SQA Architecture



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The SQA system – an SQA Architecture

An SQA system always combines a wide range of SQA components

All SQA components are employed to challenge the software errors and to achieve an acceptable level of software quality.

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SQA system components can be classified into six classes

1. Pre-Project Quality Components



2. Project life cycle quality components



3. Infrastructure error preventive and improvement components



4. Software quality management components



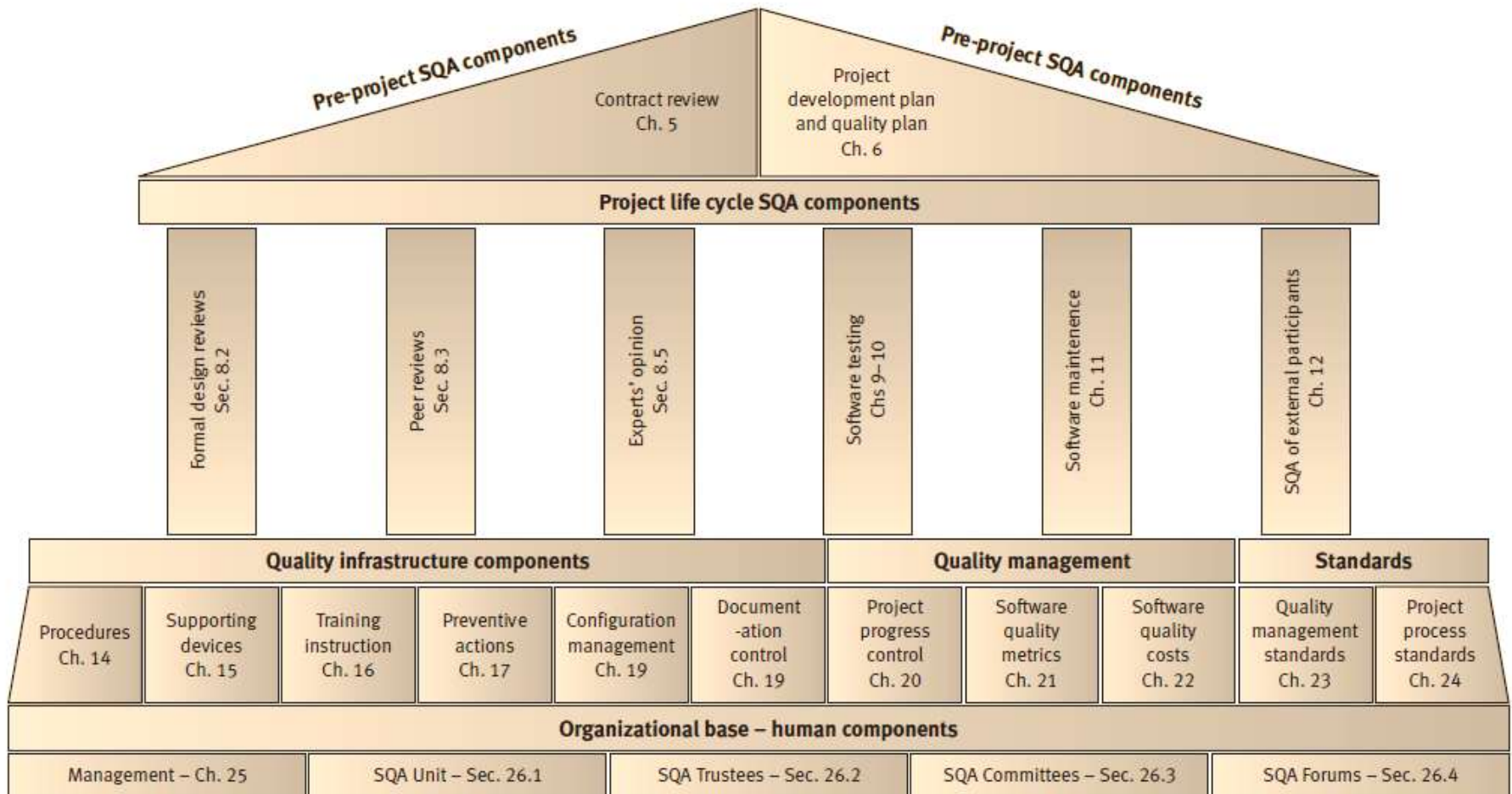
5. Standardization, certification and SQA assessment components



6. Organizing for SQA – the human components



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Pre-project Quality Components

To improve the preparatory steps taken prior to initiating work on the project itself.

1. Contract review
2. Development and quality plans

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Pre-project Quality Components

1. Contract review

Once a software development contract has been signed a plan is prepared for the project (“development plan”) and its integrated quality assurance activities (“quality plan”).

The main issues treated in the project development plan are:

- Schedules
- Required manpower and hardware resources
- Risk evaluations
- Organizational issues: team members, subcontractors and partnerships
- Project methodology, development tools, etc.
- Software reuse plans.

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Pre-project Quality Components

1. Contract review

The main issues treated in the project's quality plan are:

- Quality goals, expressed in the appropriate measurable terms
- Criteria for starting and ending each project stage
- Lists of reviews, tests, and other scheduled verification and validation activities.

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Project Life Cycle Quality Components

The project life cycle is composed of two stages: the development life cycle stage and the operation–maintenance stage.

The main components are:

- Reviews
- Expert opinions
- Software testing
- Software maintenance
- Assurance of the quality of the subcontractors' work and the customer supplied parts.

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Project Life Cycle Quality Components

1. Reviews

The design phase of the development process produces a variety of documents.

- Design reports,
- Software test documents,
- Software installation plans and
- Software manuals.

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Project Life Cycle Quality Components

Formal design reviews (DRs)

- Formal professional approval
- Developer can continue to the next phase of the development process only on receipt of formal approval
- The committees composed of senior professionals, including the project leader , the department manager, the chief software engineer, and heads of other related departments and the customer's representative

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Project Life Cycle Quality Components

Peer reviews

- Peer reviews are reviewing short documents, parts of a report, a coded software module
- Usually, the reviewers are all peers, not superiors, who provide professional assistance to colleagues.
- The main objective of Peer review is to detect as many design and programming faults as possible.

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Project Life Cycle Quality Components

2. Expert opinions

- Expert opinions provide additional external support to the organization's in-house development process.
- This is useful in the following situations:
 - Insufficient in-house professional capabilities in a given area.
 - In small organizations in many cases it is difficult to find enough suitable candidates to participate in the design review teams.
 - In small organizations an outside expert's opinion can replace an inspection.
 - Temporary inaccessibility of in-house professionals
 - In cases of major disagreement among the organization's senior professionals, an outside expert may support a decision.

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Project Life Cycle Quality Components

3. Software testing

- Software tests are targeted toward review of the actual running of the software.
- Software tests examine software modules, software integration, or entire software packages(systems).
- Recurrent tests (usually termed “regression tests”), carried out after correction of previous test findings, are continued till satisfactory results are obtained.
- Software testing programs are constructed from a variety of tests, some manual and some automated
- It is recommended that software tests be carried out by an independent, outside testing unit rather than by the project team.

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Project Life Cycle Quality Components

4. Software maintenance components

- Software maintenance services fall into the following categories:
 - Corrective maintenance – correction of software code and documentation failures.
 - Adaptive maintenance – Adaptation of current software to new circumstances and customers without changing the basic software product
 - Functionality improvement maintenance – The functional and performance-related improvement of existing software

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Project Life Cycle Quality Components

5. Assurance of the quality of the subcontractors' work and the customer supplied parts

- Subcontractors and customers frequently join with the developers in carrying out software development projects.
- The larger and more complex the project, the greater the external participants will be required, and the larger the proportion of work transmitted to them (subcontractors and the customer).
- special software assurance efforts are required to establish effective controls over the external participant's work.
- Special SQA efforts are needed to assure the quality of the hardware, software, staff and training supplied by the customer.

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Project Life Cycle Quality Components

The main SQA maintenance components are as follows.

- **Pre-maintenance components**
 - Maintenance contract review
 - Maintenance plan.
- **Software development life cycle components**
 - These components will improve and adaptive maintenance tasks
- **Infrastructure SQA components**
 - Maintenance procedures and instructions
 - Supporting quality devices
 - Maintenance staff training, retraining, and certification
 - Maintenance preventive and corrective actions
 - Configuration management
 - Control of maintenance documentation and quality records.

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Project Life Cycle Quality Components

- **Managerial control SQA components**
 - Maintenance service control
 - Maintenance quality metrics
 - Maintenance quality costs.

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Infrastructure error preventive and improvement components

- The goals are the prevention of software faults or, at least, the lowering of software fault rates, together with the improvement of productivity.
- This SQA components includes:
 - Procedures and work instructions
 - Supporting quality devices
 - Staff training, retraining, and certification
 - Preventive and corrective actions
 - Configuration management
 - Documentation control.

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Infrastructure error preventive and improvement components

1. Procedures and work instructions

- Procedures usually provide detailed definitions for the performance of specific types of development activities in a way that assures effective achievement of quality results
- Work instructions, provide detailed directions for the use of methods that are applied in unique instances and employed by specialized teams.

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Infrastructure error preventive and improvement components

2. Supporting quality devices

- One way to combine higher quality with higher efficiency is to use supporting quality devices, such as templates and checklists
- This will contribute:
 - Saving the time required to define the structure of the various documents or prepare lists of subjects to be reviewed.
 - Contributing to the completeness of the documents and reviews.
 - Improving communication between development team and review committee members by standardizing documents and agendas.

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Infrastructure error preventive and improvement components

3. Staff training, instruction and certification

- Within the framework of SQA, keeping an organization's human resources knowledgeable and updated at the level required is achieved mainly by:
 - Training new employees and retraining those employees who have changed assignments.
 - Continuously updating staff with respect to professional developments and the in-house, hands-on experience acquired.
 - Certifying employees after their knowledge and ability have been demonstrated.

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Infrastructure error preventive and improvement components

4. Preventive and corrective actions

- Implementation of changes that prevent similar failures in the future.
- Correction of similar faults found in other projects and among the activities performed by other teams.
- Implementing proven successful methodologies to enhance the probability of repeat successes.

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Infrastructure error preventive and improvement components

5. Configuration management

- The regular software development and maintenance operations involve intensive activities that modify software to create new versions and releases.
- These activities are conducted throughout the entire software service period in order to cope with the needed corrections, adaptations to specific customer requirements, application improvements, etc.
- Different team members carry out these activities simultaneously, that may take place at different sites.
- As a result, serious dangers arise, whether of misidentification of the versions or releases, loss of the records delineating the changes implemented, or loss of documentation. Consequently failures may be caused.

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Infrastructure error preventive and improvement components

- Configuration management deals with these hazards by introducing procedures to control the change process.
- These procedures relate to the approval of changes, the recording of those changes performed, the issuing of new software versions and releases, the recording of the version and release specifications of the software installed in each site, and the prevention of any changes in approved versions and releases once they are issued.
- Most configuration management systems implement computerized tools to accomplish their tasks. These computerized systems provide the updated and proper versions of the installed software for purposes of further development or correction.
- Software configuration procedures generally authorize an administrator or a configuration management committee to manage all the required configuration management operations.

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Infrastructure error preventive and improvement components

6. Documentation control

- To ensure the efficient long-term availability of major documents related to software development
- The purpose of one type of controlled document – the quality record – is mainly to provide evidence of the SQA system's performance.
- Documentation control functions refer mainly to customer requirement documents, contract documents, design reports, project plans, development standards, etc.
- Documentation control activities involve:
 - Definition of the types of controlled documents needed
 - Specification of the formats, document identification methods, etc.
 - Definition of review and approval processes for each controlled document
 - Definition of the archive storage methods.

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Infrastructure error preventive and improvement components

6. Documentation control

- Controlled documents contain information important to the long-term development and maintenance of the software system, such as software test results, design review (DR) reports, problem reports, and audit reports.

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Management SQA components

- Managerial SQA components support the managerial control of software development projects and maintenance services.
- Control components include:
 - Project progress control (including maintenance contract control)
 - Software quality metrics
 - Software quality costs.

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Management SQA components

1. Project progress control

- The main objective of project progress control components is to detect the appearance of any situation that may induce deviations from the project's plans and maintenance service performance.
- Project control activities focus on:
 - Resource usage
 - Schedules
 - Risk management activities
 - The budget

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Management SQA components

2. Software quality metrics

- Measurement of the various aspects of software quality for the support of control activities and the initiation of process improvements during the development and the maintenance phases.
- Software quality metrics
 - Quality of software development and maintenance activities
 - Development teams' productivity
 - Help desk and maintenance teams' productivity
 - Software faults density
 - Schedule deviations

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Management SQA components

3. Software quality costs

- The quality costs incurred by software development and application are, according to the extended quality costs model,
 - The costs of control (prevention costs, appraisal costs, and managerial preparation and control costs)
 - The costs of failure (internal failure costs, external failure costs, and managerial failure costs).

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Standardization, certification and SQA assessment components

- External tools offer another avenue for achieving the goals of software quality assurance. Specifically, the main objectives of this class of components are:
 1. Utilization of international professional knowledge.
 2. Improvement of coordination with other organizations' quality systems.
 3. Objective professional evaluation and measurement of the achievements of the organization's quality systems.
- The standards available may be classified into two main sub-classes:
 - Quality management standards and
 - Project process standards.

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Standardization, certification and SQA assessment components

1. Quality management standards

- Guide the management of software development, maintenance, SQA standards, system certification, and assessment components and infrastructure.
- These standards focus on what is required and leave the decision about how to achieve it to the organization
- The most familiar examples of this type of standard are:
 - SEI CMM assessment standard
 - ISO 9001 and ISO 9000-3 standards.

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Standardization, certification and SQA assessment components

2. Project process standards

- Project process standards are professional standards that provide methodological guidelines for the development team.
- Well-known examples of this type of standards are:
 - IEEE 1012 standard
 - ISO/IEC 12207 standard.

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Organizing for SQA – The Human Components

- Includes the organization's management, software testing personnel and SQA units in addition to professionals and other practitioners interested in software quality (SQA trustees, SQA committee members and SQA forum members).
- The main objectives of the SQA organizational base are as follows:
 - To develop and support implementation of SQA components.
 - To detect deviations from SQA procedures and methodology.
 - To suggest improvements to SQA components.

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Organizing for SQA – The Human Components

Management's role in SQA

- Definition of the quality policy
- Effective follow-up of quality policy implementation
- Allocation of sufficient resources to implement quality policy
- Assignment of adequate staff
- Follow-up of compliance of quality assurance procedures
- Solutions of schedule, budget and customer relations difficulties.

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Organizing for SQA – The Human Components

The SQA unit

- Preparation of annual quality programs
- Consultation with in-house staff and outside experts on software quality issues
- Conduct of internal quality assurance audits
- Leadership of quality assurance various committees
- Support of existing quality assurance infrastructure components and their updates, and development of new components.

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Organizing for SQA – The Human Components

SQA trustees, committees and forums

- SQA trustees are members of development and maintenance teams who have a special interest in software quality and their contributions include:
 - Solving team or unit local quality problems
 - Detecting deviations from quality procedures and instructions
 - Initiating improvements in SQA components
 - Reporting to the SQA unit about quality issues in their team or unit.

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Organizing for SQA – The Human Components

SQA committee members

- SQA committee members are members of various software development and maintenance units.
- The main issues dealt with by the committees are:
 - Solution of software quality problems.
 - Analysis of problem and failure records as well as other records, followed by initiation of corrective and preventive actions when appropriate.
 - Initiation and development of new procedures and instructions; updating existing materials.
 - Initiation and development of new SQA components and improvement of existing components.

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Organizing for SQA – The Human Components

SQA forums

SQA forums are composed of professionals and practitioners who meet and/or maintain an Internet site on a voluntary basis for discussion of quality issues pertaining to development and maintenance processes. They share their experiences and difficulties as well as try to initiate improvements in the software process. The forums can therefore be considered as important sources of information and SQA initiatives.

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The main considerations affecting the use of the SQA components

Organizational considerations

- Type of software development clientele
- Type of software maintenance clientele
- Range of software products
- Size of the organization
- Degree and nature of cooperation with other organizations carrying out related projects
- Optimization objectives

Project and maintenance service considerations

- Level of complexity and difficulty
- Degrees of experience with the project technology
- Extent of software reuse in the new projects

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Professional staff considerations

- Professional qualifications
- Level of acquaintance with team members

Summary



SQA System Components



**SQA Maintenance
Components**



**Affects SQA
Components?**