Software Quality Assurance

CHAPTER 2

THE COMPONENTS OF THE SOFTWARE QUALITY ASSURANCE

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Daniel Galin

Definition

An SQA system always combines a wide range of SQA components, all of which are employed to challenge the huge number of sources of software errors and to achieve an acceptable level of software quality.
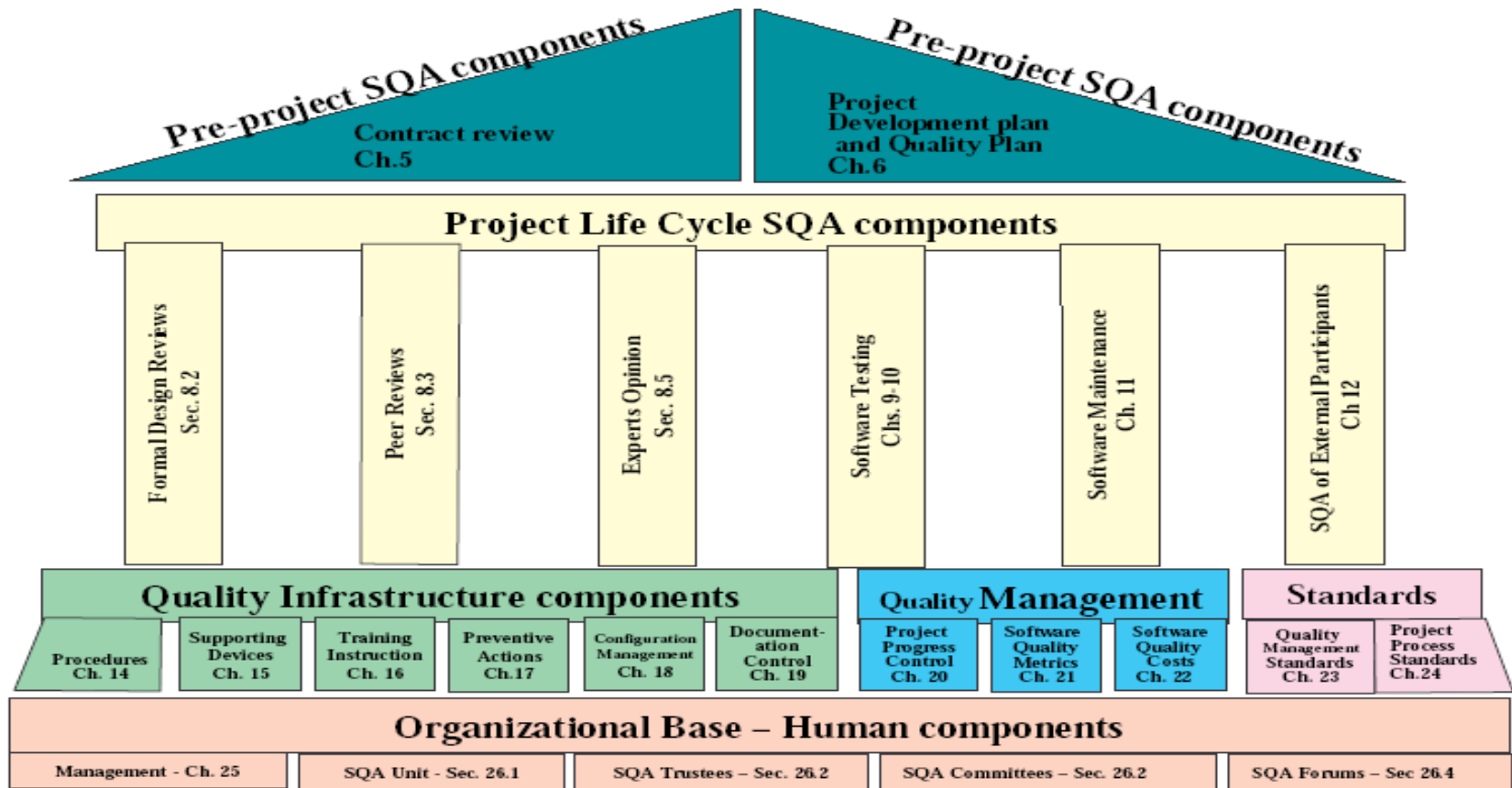
SQA System - Architecture

SQA system components can be classified into six classes:

1. Pre-project components

2. Software project life cycle components

3. Components of infrastructure error prevention and improvement.

4. Components of software quality management

5. Components of standardization, certification, and SQA system assessment.

6. Organizing for SQA – the human components

SQA System - Architecture

The Software Quality Shrine

Pre-project SQA components

Contract review
Ch.5

Pre-project SQA components

Project Development plan and Quality Plan
Ch.6

Project Life Cycle SQA components

Formal Design Reviews Sec. 8.2

Peer Reviews Sec. 8.3

Experts Opinion Sec. 8.5

Software Testing Chs. 9-10

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Quality Infrastructure components

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Pre-project SQA components

Pre-project SQA components, to assure that:

(a) The project commitments have been adequately defined considering the resources required, the schedule and budget; and

(b) The development and quality plans have been correctly determined.

Pre-project SQA components

The SQA components belonging here are meant to improve the preparatory steps taken prior to initiating work on the project itself:

Contract review

Development and quality plans.

Pre-project SQA components

Contract Review

Accordingly, contract review activities must include a detailed examination of

(a) the project proposal draft and

(b) the contract drafts.

Pre-project SQA components

Contract review activities include:

- Clarification of the customer's requirements

- Review of the project's schedule and resource requirement estimates

- Evaluation of the professional staff's capacity to carry out the proposed project

- Evaluation of the customer's capacity to fulfill his obligations

- Evaluation of development risks.

Pre-project SQA components

Development and quality plans

Once a software development contract has been signed or a commitment made to undertake an internal project for the benefit of another department of the organization, a plan is prepared of the project ("development plan")

and its integrated quality assurance activities ("quality plan").

Pre-project SQA components

Development plan

Needed after signing the contract. Changes may occur hence review With respect to:

Schedules

Required manpower and hardware resources

Risk evaluations

Organizational issues: team members, subcontractors and partnerships

Project methodology, development tools, etc.

Software reuse plans.

Pre-project SQA components

Quality plan

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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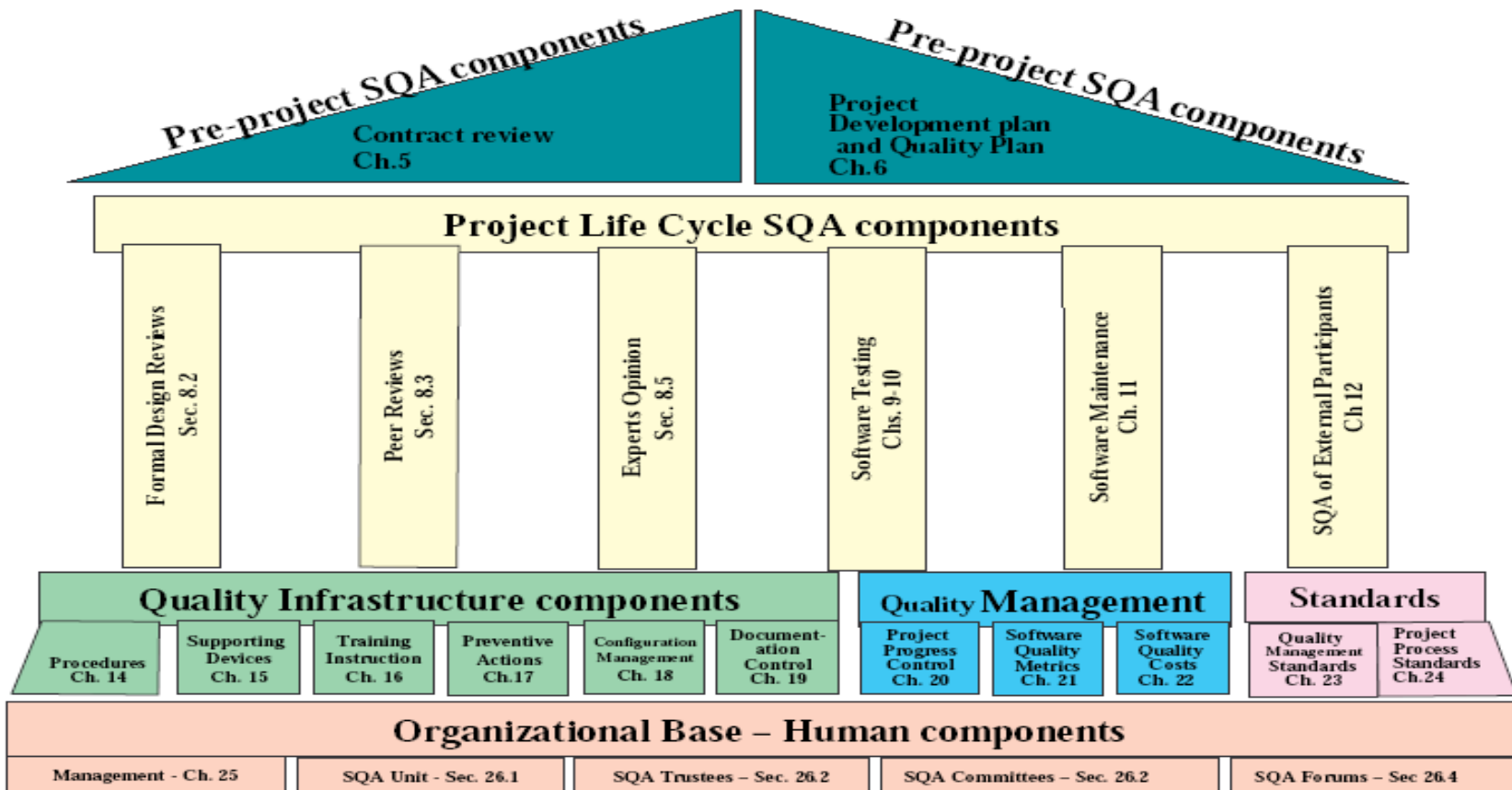
Software project life cycle components

Several SQA components enter the software development project life cycle at different points. Their use should be planned prior to the project's initiation. The main components are:

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

Software project life cycle components

Reviews

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

The printed products include design reports, software test documents, software installation plans and software manuals, among others. Reviews can be categorized as formal design reviews (DRs) and peer reviews.

Software project life cycle components

Formal design reviews (DRs)

Committees whose members examine the documents presented by the development teams usually carry out formal design reviews

The committees are composed of senior professionals, including the project leader and, usually, the department manager, the chief software engineer, and heads of other related departments

Software project life cycle components

Peer reviews

Peer reviews (inspections and walkthroughs) are directed at reviewing short documents, chapters or parts of a report, a coded printout of a software module, and the like.

Inspections and walkthroughs can take several forms and use many methods; usually, the reviewers are all peers, not superiors, who provide professional assistance to colleagues. The main objective of inspections and walkthroughs is to detect as many design and programming faults as possible.

Software project life cycle components

Expert opinions, prepared by outside experts, support quality evaluation by introducing additional capabilities to the internal review staff.

Outside experts transmit their expertise by either:

- Preparing an expert's judgment about a document or a code section.

- Participating as a member of an internal design review, inspection or walkthrough team.

Software project life cycle components

Software tests are formal SQA components that are targeted toward review of the actual running of the software. The tests are based on a prepared list of test cases that represent a variety of expected scenarios.

Software project life cycle components

Software maintenance components

Software maintenance services vary in range and are provided for extensive periods, often several years. These services fall into the following categories:

1. **Corrective maintenance** – **User's support services and correction of software** code and documentation failures.

2. **Adaptive maintenance** – **Adaptation of current software to new circumstances** and customers without changing the basic software product. These adaptations are usually required when the hardware system or its components undergo modification (additions or changes).

3. **Functionality improvement maintenance** – **The functional and performance-** related improvement of existing software, carried out with respect to limited issues.

Software project life cycle components

Assurance of the quality of the external participant's work

The larger and more complex the project, the greater the likelihood that external participants will be required, and the larger the proportion of work transmitted to them (subcontractors, suppliers of COTS software and the customer).

Software project life cycle components

Most of the SQA controls applied to external participants are defined in the contracts signed between the relevant parties. If an external participant's work is performed using software assurance standards below those of the supplier's, risks of not meeting schedule or other requirements are introduced into the project

Software project life cycle components

Hence, 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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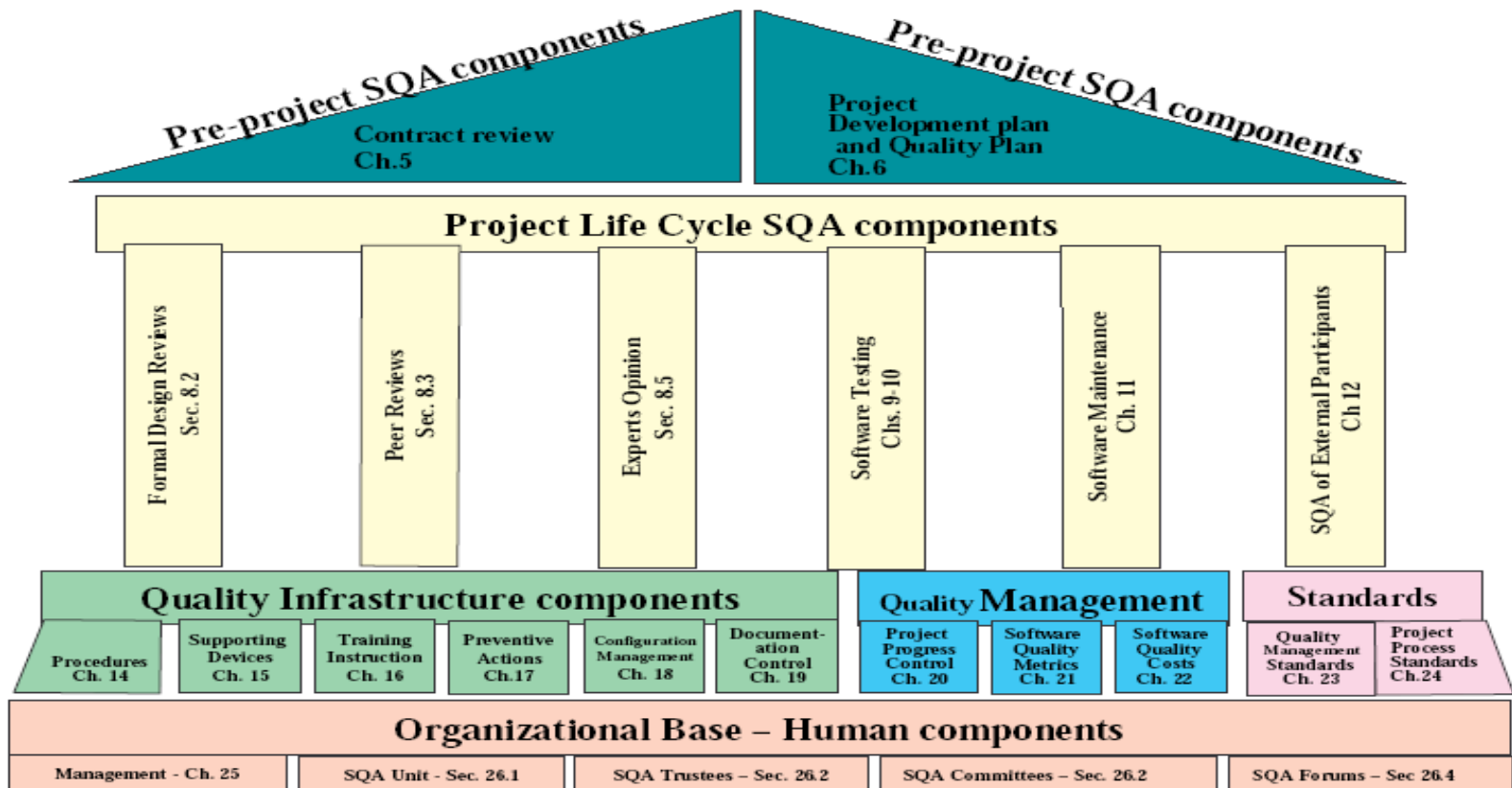
Infrastructure components for error prevention and improvement

The goals of SQA infrastructure are the prevention of software faults or, at least, the lowering of software fault rates, together with the improvement of productivity.

Infrastructure components for error prevention and improvement

This class of SQA components includes:

- Procedures and work instructions

- Supporting quality devices

- Staff training, retraining, and certification

- Preventive and corrective actions

- Configuration management

- Documentation control.

Infrastructure components for error prevention and improvement

Procedures and work instructions

Quality assurance procedures usually provide detailed definitions for the performance of specific types of development activities in a way that assures effective achievement of quality results.

Procedures are planned to be generally applicable and to serve the entire organization.

Infrastructure components for error prevention and improvement

Because they reflect the organization's past experience, constant care should be taken to update and adjust those procedures and instructions to current technological, organizational, and other conditions

Infrastructure components for error prevention and improvement

Supporting quality devices

One way to combine higher quality with higher efficiency is to use supporting quality devices, such as templates and checklists. These devices, based as they are on the accumulated knowledge and experience of the organization's development and maintenance professionals, contribute to meeting SQA goals.

Infrastructure components for error prevention and improvement

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.

Infrastructure components for error prevention and improvement

Preventive and corrective actions

Systematic study of the data collected regarding instances of failure and success contributes to the quality assurance process in many ways. Among them we can list:

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.

Infrastructure components for error prevention and improvement

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 (usually lasting several years) in order to cope with the needed corrections, adaptations to specific customer requirements, application improvements, and so forth.

Infrastructure components for error prevention and improvement

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.

Quality records mainly contribute to the system's ability to respond to customer claims in the future

Infrastructure components for error prevention and improvement

Documentation control activities entail:

■ 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.
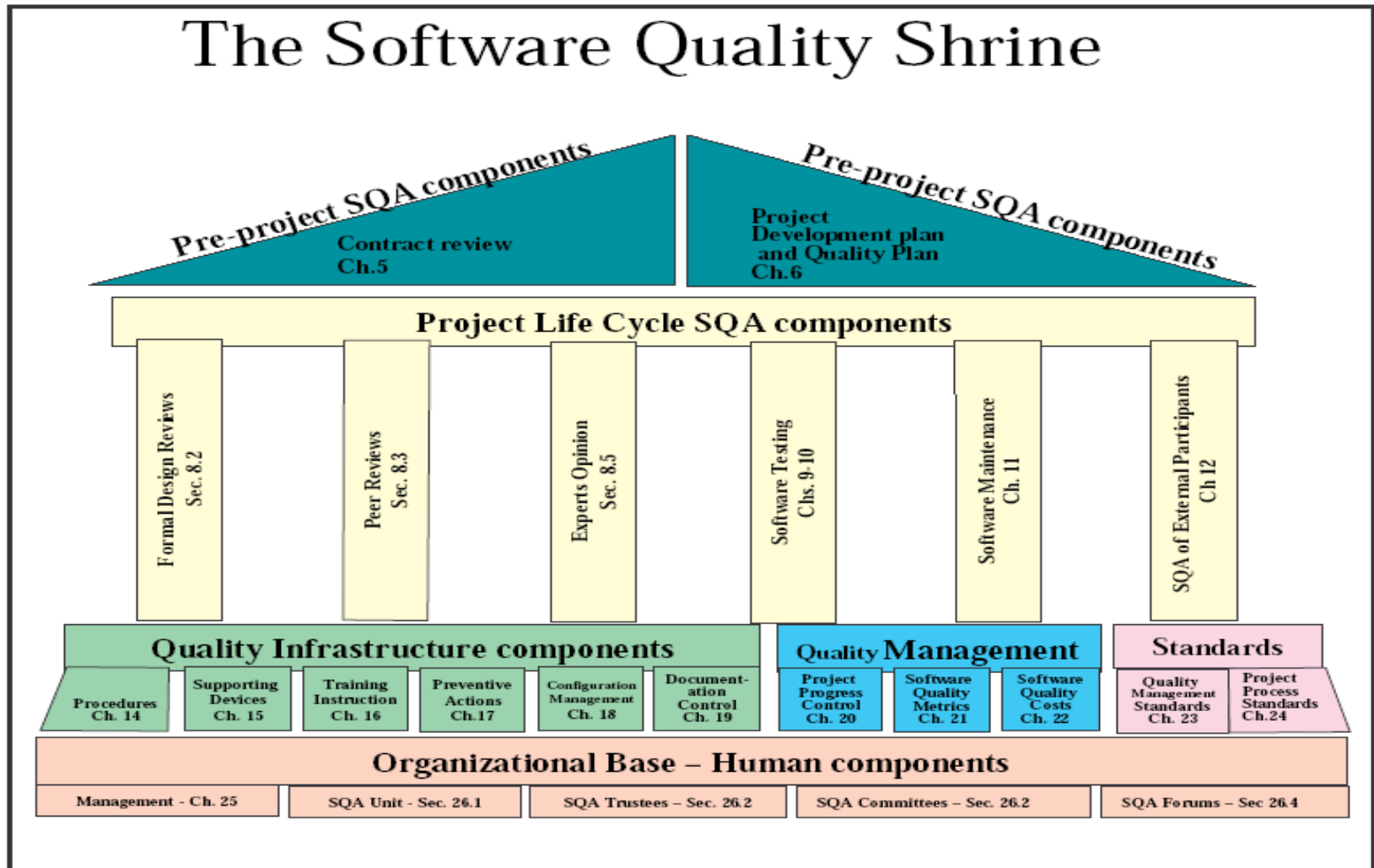
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Management SQA components

Managerial SQA components support the managerial control of software development projects and maintenance services. Control components include:

- Project progress control
- Software quality metrics
- Software quality costs.

Management SQA components

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. Clearly, the effectiveness and efficiency of the corrective measures implemented is dependent on the timely discovery of undesirable situations.

Management SQA components

Project control activities focus on:

- *Resource usage*

- *Schedules*

- *Risk management activities*

- *The budget.*

Management SQA components

Software quality metrics

Measurement of the various aspects of software quality is considered to be an effective tool for the support of control activities and the initiation of process improvements during the development and the maintenance phases.

These measurements apply to the functional quality, productivity, and organizational aspects of the project.

Management SQA components

Among the software quality metrics available or still in the process of development, we can list metrics for:

Quality of software development and maintenance activities

Development teams' productivity

Help desk and maintenance teams' productivity

Software faults density

Schedule deviation.

Management SQA components

Software quality costs

The quality costs gained by software development and application are the *costs of control* (prevention costs, evaluation costs, and managerial preparation and control costs) combined with *the costs of failure* (internal failure costs, external failure costs, and managerial failure costs). Management is especially interested in the total sum of the quality costs.

Management SQA components

It is believed that up to a certain level, expanding the resources allocated to control activities yields much larger savings in failure costs while reducing total quality costs.
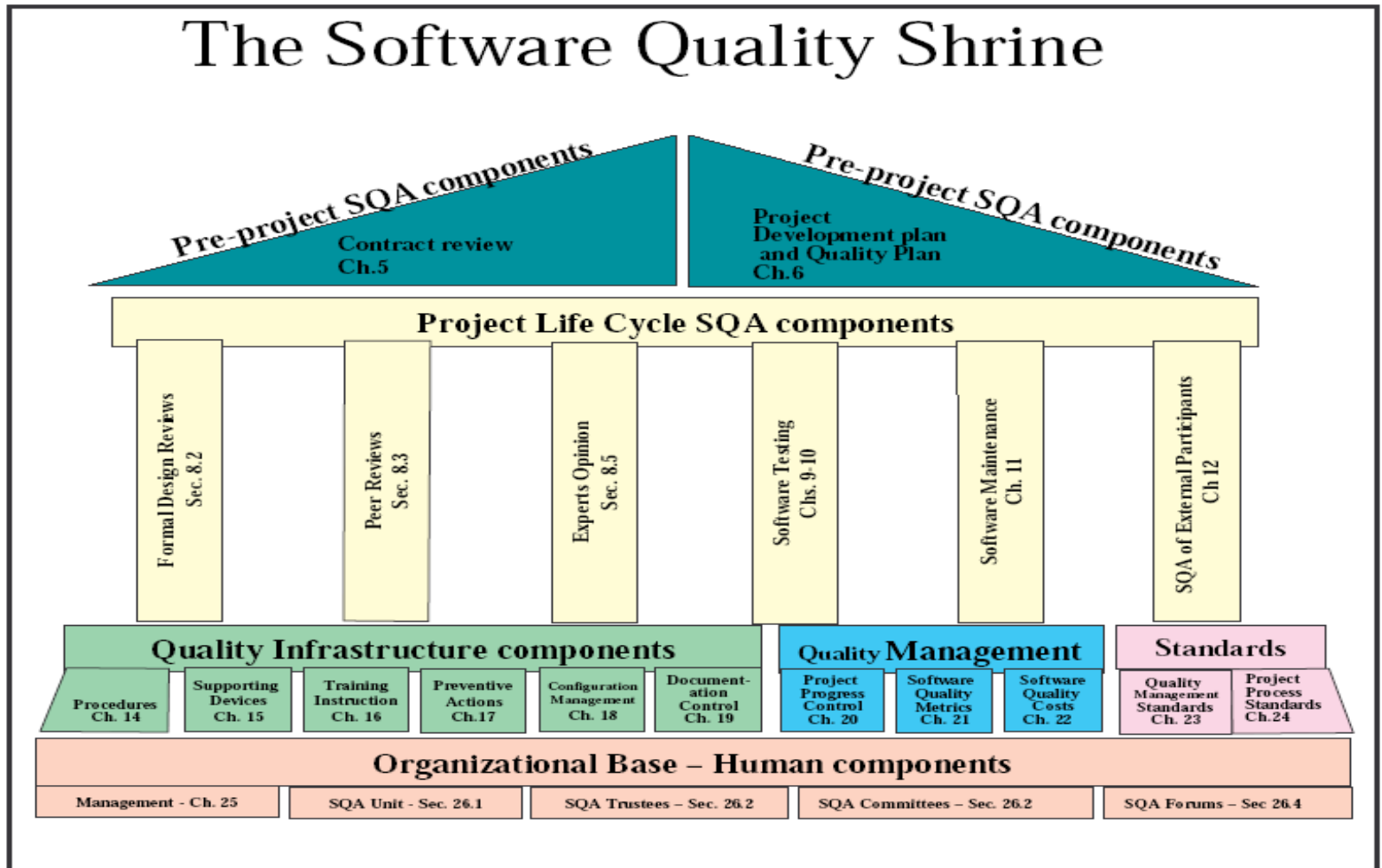
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SQA standards, system certification, and assessment components

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.

SQA standards, system certification, and assessment components

The standards available may be classified into two main sub-classes:

- Quality management standards
- project process standards

SQA standards, system certification, and assessment components

Quality management standards

The organization can clearly benefit from quality standards of the sub-class that guide the management of software development, maintenance, and infrastructure. These standards focus on *what is required and leave the* decision about *how to achieve it to the organization.*

SQA standards, system certification, and assessment components

The most familiar examples of this type of standard are:

SEI CMM assessment standard

ISO 9001 and ISO 9000-3 standards

SQA standards, system certification, and assessment components

Project process standards

Project process standards are professional standards that provide methodological guidelines (dealing with the question of "how") for the development team. Well-known examples of this type of standards are:

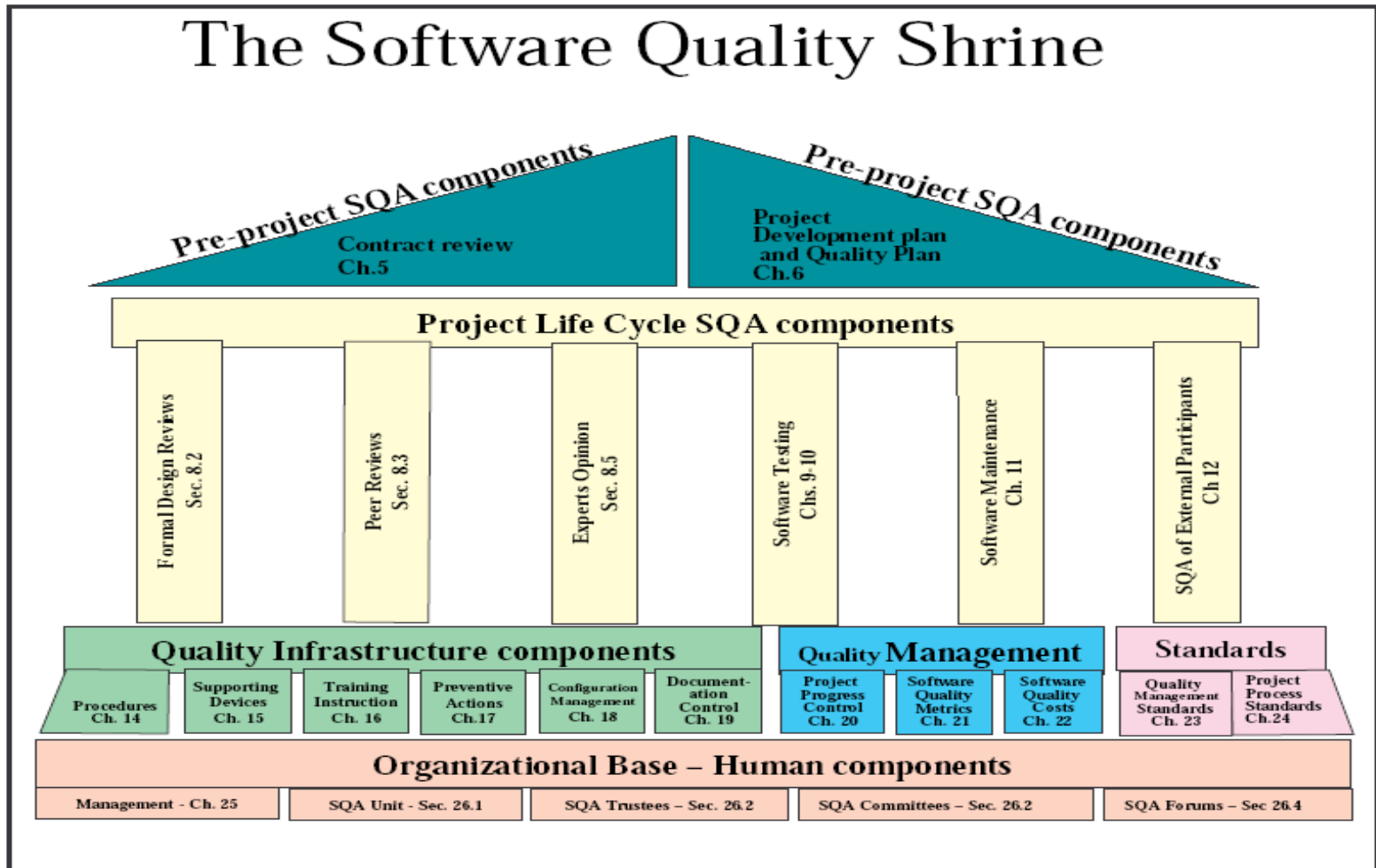IEEE 1012 standard

ISO/IEC 12207 standard

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Organizing for SQA – the human components

SQA components cannot be applied in an organizational vacuum: they require an organizational base. This base 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).

Organizing for SQA – the human components

The human components are:

- Management's role in SQA

- The SQA unit

- SQA trustees

- SQA committee members

Organizing for SQA – the human components

Management's role in SQA

The responsibilities of top management (through the executive in charge of software quality), departmental management and project management include the following:

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.

Organizing for SQA – the human components

The SQA unit

This unit and software testers are the only parts of the SQA organizational base that devote themselves full-time to SQA matters. All other segments of the SQA organizational base (managerial and professional staff) contribute only some of their time to software quality issues.

Thus, the SQA unit's task is to serve as the main moving force, initiator, and coordinator of the SQA system and its application.

Organizing for SQA – the human components

This task can be broken down into a number of primary roles:

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.

Organizing for SQA – the human components

SQA trustees are members of development and maintenance teams who have a special interest in software quality and are prepared to devote part of their time to these issues. 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.

Organizing for SQA – the human components

SQA committee members are members of various software development and maintenance units, and are usually appointed for term or *ad hoc service. 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.

Organizing for SQA – the human components

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.

End