

Standards, Certification and Assessment

SCS3207/ IS3103

Overview

Benefits of Standardization

Organisations Involved in Standards Development

Contributions made by the use of standards

Classification of SQA Standards

Quality Management Standards (Certification and Assessment)

Project Process Standards



Benefits of the use of SQA standards

The ability to make use of the most sophisticated and comprehensive professional methodologies and procedures

Better understanding and cooperation between users of the same standards:

- Between team members and between project teams
- Between software developers and external participants in the project
- Between suppliers and customers.

Organisations Involved in Standards Development

Institute of Electrical and Electronics Engineers (IEEE) Computer Society

International Organisation for Standardisation (ISO)

US Department of Defence (DoD)

American National Standards Institute (ANSI)

International Electro-technical Commission (IEC)

Electronic Industries Association (EIA)

International Telecommunication Union (ITU)

World Standards Cooperation (formed by ISO, IEC and ITU)

The ways in which organisations contribute to SQA

- Standards: They provide constantly updated software quality standards, used internationally by professionals and SQ managers.
E.g. : the ISO (SQA management standards) and the IEEE (SQA/ software engineering professional standards)
- Certification: They also provide SQA certification, through independent auditors. The certification is only valid till the next periodic audit.
E.g. : The ISO 9000 Certification Service is currently the most prominent granters of certification in Europe.
- Assessment: Professional support is also given by these organisations. They provide tools for “self-assessment”. Organisation-created assessment programs have detailed documentation which act as instruction manuals.
E.g. : the Capability Maturity Model (CMM) and ISO/IEC Std 15504

ISO/IEC 9126

Defines a quality model for software product evaluation

The objective of the ISO/IEC 9126 standard is to address some of the well-known human biases that can adversely affect the delivery and perception of a software development project.

- E.g. : changing priorities after the start of a project, not having any clear definitions of "success."

ISO/IEC 9126 cont..

By clarifying, then agreeing on the project priorities and subsequently converting abstract priorities (compliance) to measurable values, ISO/IEC 9126 tries to develop a common understanding of the project's objectives and goals.

An extension of previous work done by McCall (1977), Boehm (1978), FURPS and others in defining a set of software quality characteristics.

ISO/IEC 9126 is revised by ISO/IEC 25010:2011

ISO/IEC 25010:2011 : Systems and software engineering -- (SQuaRE) -- System and software quality models

From the The ISO/IEC 25000 series of standards : Systems and software Quality Requirements and Evaluation (SQuaRE) [<http://iso25000.com/index.php/en/iso-25000-standards>]

Defines Quality Characteristics

Classification of SQA Standards

1. Quality management standards, including certification and assessment methodologies
2. Project process standards

Table VI.1: Classes of SQA standards – comparison

Characteristics	Quality management standards	Project process standards
The target unit	Management of software development and/or maintenance and the specific SQA units	A software development and/or maintenance project team
The main focus	Organization of SQA systems, infrastructure and requirements	Methodologies for carrying out software development and maintenance projects
The standard's objective	"What" to achieve	"How" to perform
The standard's goal	Assuring supplier's software quality and assessing its software process capability	Assuring the quality of a specific software project
Examples	ISO 9000-3 SEI's CMM	ISO/IEC 12207 IEEE Std 1012-1998

Quality Management Standards

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Quality Management Standards

These include certification and assessment methods.

These focus on the organization's SQA system, infrastructure and requirements, while leaving the choice of methods and tools to the organization.

By complying with quality management standards, organizations can steadily assure that their software products achieve an acceptable level of quality.

E.g. : The ISO 9000-3 (revised by ISO/IEC 90003:2014) and the Capability Maturity Model (CMM) (revised by CMMI).

Some current software development tenders require participants to be certified according to one of the quality management standards

Quality Management Standards cont..

- Certification : Standards belonging to this class, structure the SQA certification procedures that are applied to organizations developing software.

E.g. : ISO 9000-3 (revised by ISO/IEC 90003:2014)

Emphasis is external : to support the supplier-customer relationships

- Assessment : Standards and methodologies of this class serve mainly for assessment of the organization's SQA achievements while they guide development of its SQA system.

E.g. : CMM (revised by CMMI), Bootstrap, ISO/IEC 15504

Emphasis is internal : focuses on software process improvement

An Example of a Certification standard: ISO/IEC 90003:2014

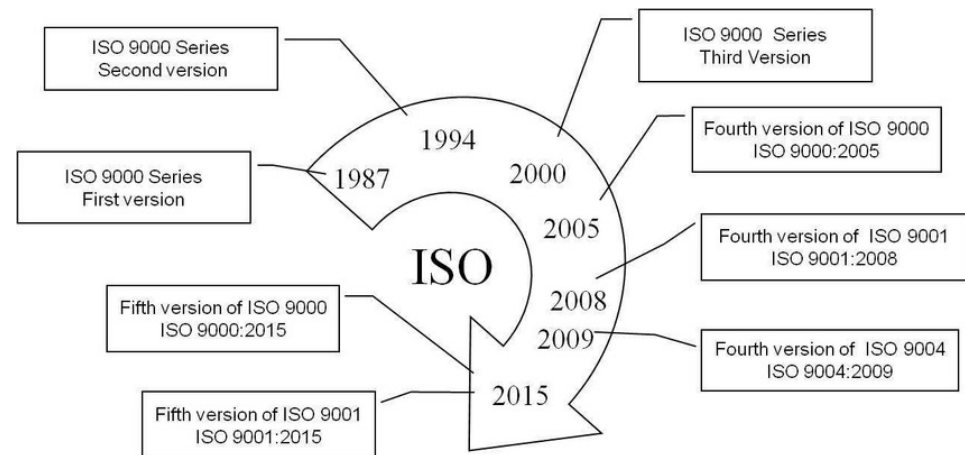
ISO/IEC 90003:2014 provides guidance for organizations in the application of ISO 9001:2008 to the acquisition, supply, development, operation and maintenance of computer software and related support services.

ISO/IEC 90003:2014 does not add to or otherwise change the requirements of ISO 9001:2008.

The guidelines provided in ISO/IEC 90003:2014 are not intended to be used as assessment criteria in quality management system registration/certification.

ISO 9000

- ISO (international Standards Organization) is a consortium of 63 countries established to formulate and foster standardization.
- ISO published its 9000 series of standards in 1987.



What is ISO 9000 Certification?

ISO 9000 certification serves as a reference for contract between independent parties.

The ISO 9000 standard specifies guidelines for maintaining a quality system.

ISO 9000 specifies:

- guidelines for repeatable and high-quality product development.
- Also addresses organizational aspects
- responsibilities, reporting, procedures, processes, and resources for implementing quality management.

What is ISO 9000 Certification? Cont..

A set of guidelines for the production process.

- not directly concerned about the product itself.
- a series of three standards: ISO 9001, ISO 9002, and ISO 9003.

Based on the premise:

- if a proper process is followed for production good quality products are bound to follow.

ISO 9001

Applies to:

- organizations engaged in design, development, production, and servicing of goods.
- applicable to most software development organizations.

ISO 9002

ISO 9002 applies to organizations who do not design products, but are only involved in production.

Examples of this category of industries:

- steel or car manufacturing industries
- buy the product and plant designs from external sources; only manufacture products.
- not applicable to software development organizations.

ISO 9003

ISO 9003 applies to organizations involved only in installation and testing of the products.

ISO 9000 for Software Industry

ISO 9000 is a generic standard is applicable to many industries, starting from a steel manufacturing industry to a service rendering company.

Many clauses of ISO 9000 documents:

- use generic terminologies
- very difficult to interpret them in the context of software organizations.

Software vs Other Industries

It is very difficult to interpret many clauses for software industry because software development is radically different from development of other products.

Software is intangible therefore difficult to control. It is difficult to control anything that we cannot see and feel.

- In contrast, in a car manufacturing unit we can see a product being developed through stages such as fitting engine, fitting doors etc. One can accurately tell about the status of the product at any time.

Software project management is an altogether a different concept

Software vs Other Industries cont..

During software development the only raw material consumed is data.

For any other product development lot of raw materials are consumed

- e.g. Steel industry consumes large volumes of iron ore, coal, limestone, etc.

ISO 9000 standards have many clauses corresponding to raw material control.

- not relevant to software organizations.



Why Get ISO 9000 Certification?

Confidence of customers in an organization increases if the organization is qualified for ISO 9001 certification. This is especially true in the international market.

Many international software development contracts insist development organization to have ISO 9000 certification.

Makes development process focused, efficient, and cost-effective

Why Get ISO 9000 Certification? Cont..

Points out the weakness of an organizations and recommends remedial action.

Sets the basic framework for development of an optimal process and Total Quality Management.

Requires a well-documented software production process to be in place.
This contributes to repeatable and higher quality software.

How to Get ISO 9000 Certification?

- Application stage: Applies to a registrar for registration.
- Pre-assessment: the registrar makes a rough assessment of the organization.
- Document review and adequacy audit:
 - process and quality-related documents.
 - the registrar reviews the documents
 - makes suggestions for improvements.

How to Get ISO 9000 Certification? Cont..

- Compliance audit: the registrar checks whether the suggestions made by it during review have been complied.
- Registration: The registrar awards ISO 9000 certificate after successful completions of all previous phases.
- Continued surveillance: The registrar continues monitoring the organization periodically.

ISO 9000 Certification

An ISO certified organization

- can use the certificate for corporate advertisements
- cannot use the certificate to advertise products.
 - ISO 9000 certifies organization's process
 - not any product of the organization.

ISO 9001:2008

- First major modification of ISO standard in 20 years occurred in 2000, and was updated in 2008 – No longer primarily a manufacturing standard, with military origins, implemented as books of procedures
- New standard addresses all products and services in all industry segments
- The new standard requires 8 principles be implemented??
- This standard has been replaced by **ISO 9001:2015**

ISO 9001:2015

The quality management principles are:

- customer focus
- leadership
- engagement of people
- process approach
- improvement
- evidence-based decision making
- relationship management

Salient features of ISO 9001 requirements

- All documents concerned with the development of a software product should be properly managed, authorized, and controlled.
- Proper plans should be prepared and progress against these plans should be monitored.
- Important documents independently checked and reviewed for effectiveness and correctness.
- The product should be tested against specification.

Shortcomings of ISO 9001 Certification

- Likely variations in the norms of awarding certificates among different accreditation agencies and among the registrars.
- Software development is a creative process: individual skills and experience is significant

An Example of an Assessment standard: CMM (1986/ 1993)

- The Capability Maturity Model (CMM) is a methodology used to develop and refine an organization's software development process.
- CMM establishes a framework for continuous process improvement.
- The model describes a five-level evolutionary path of increasingly organized and systematically more mature processes.

SEI Capability Maturity Model

- Developed by Software Engineering Institute (SEI) of the Carnegie Mellon University, USA to assist the U.S. Department of Defence (DoD) in software acquisition.
- The rationale was to include likely contractor performance as a factor in contract awards.
- Major DoD contractors began CMM-based process improvement initiatives as they vied for DoD contracts

SEI Capability Maturity Model cont..

- SEI CMM helped organizations:
 - Improve quality of software they developed
 - Realize adoption of SEI CMM model had significant business benefits.
- Can be used to predict the most likely outcome to be expected from the next project that the organization undertakes.

SEI Capability Maturity Model cont(2)

Can be used in two ways:

1. Capability evaluation

Provides a way to assess the software process capability of an organization

- Helps in selecting a contractor
- Indicates the likely contractor performance

2. Software process assessment

Used by an organization to assess its current process:

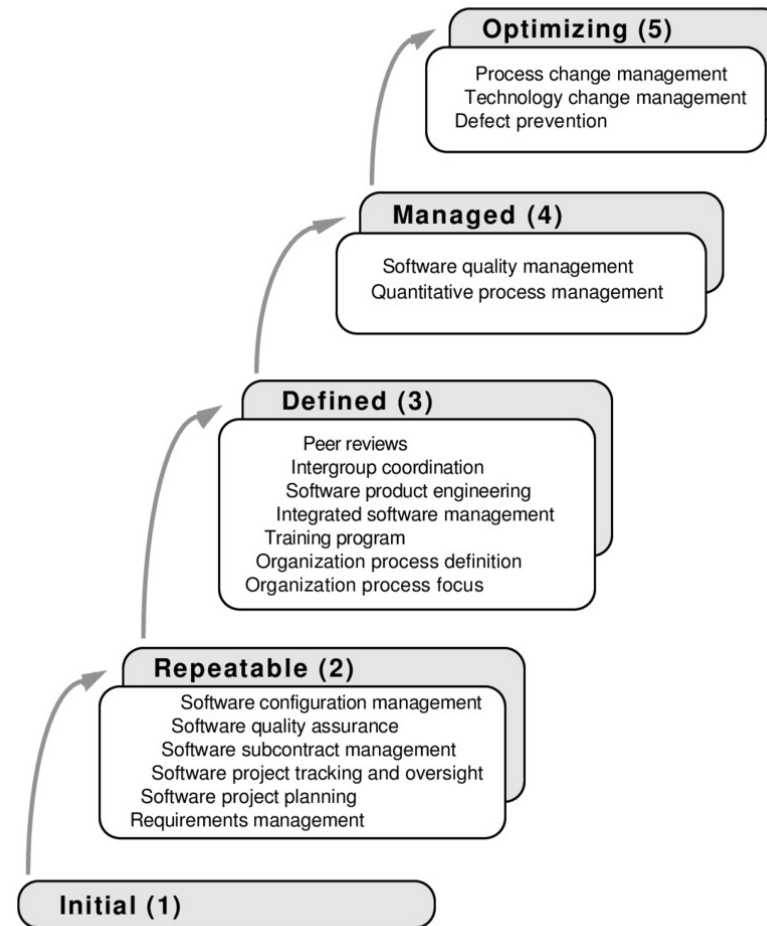
- Suggests ways to improve the process capability.
- This type of assessment is for purely internal use.

The CMM model and key process areas

The SEI CMM classifies software development industries into 5 maturity levels.

Stages are ordered so that improvements at one stage provide foundations for the next

Based on the pioneering work of Philip Crosby



Capability Maturity Model Integration (CMMI)

In the late 1990s a new developmental direction was taken – development of integrated CMM models.

The CMMI capability levels are the same as those of the original, apart from a minor change related to capability level 4, namely:

- Capability maturity level 1: Initial
- Capability maturity level 2: Managed
- Capability maturity level 3: Defined
- Capability maturity level 4: Quantitatively managed
- Capability maturity level 5: Optimizing.

CMMI Goals

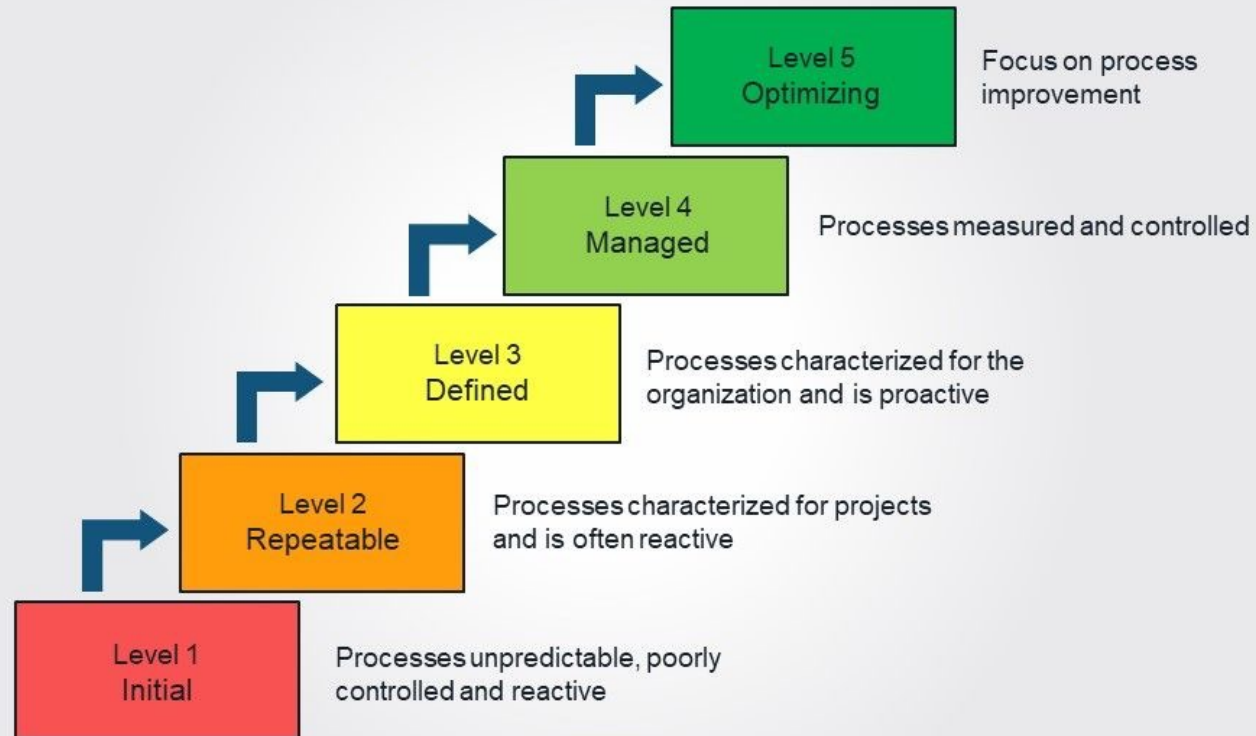
Emphasis on developing processes and changing culture for measurable benefit to organization's business objectives

Framework from which to organize and prioritize engineering, people, and business activities

Supports coordination of multi-disciplined activities required to build successful product or application

Adds "Engineering Systems Thinking"

❖ The newest version, CMMI V2.0 was released in 2018.



Read more: www.toolshero.com

Comparison of CMMI and ISO

CMMI FOCUS:

Software engineering practices

Program/project management practices

Increasing maturity levels

Appraisals when going to next maturity level

ISO 9001:2008 FOCUS:

Customer satisfaction

Process discipline across entire organization

Continual improvement

Principled management

Ch 24 : SQA project process standards

IEEE SOFTWARE ENGINEERING STANDARDS

Project Process Standards

These focus on the methodologies for carrying out software development and maintenance projects, that is, on “how” a software project is to be implemented.

They may also serve as software engineering standards.

E.g.: ISO/IEC 12207 : 2008 (revised by ISO/IEC/IEEE 12207 : 2017) and the IEEE Std 1012-2016.

Project Process Standards

These standards define the steps to be taken,

- design documentation requirements,
- the contents of design documents,
- design reviews and review issues,
- software testing to be performed and
- testing topics, and so forth.

A project process standard is devised by defining each step of a process and its attendant requirements, design documentation and contents, design review and review issues, software testing and its objectives, and so forth.

IEEE Software Engineering standards

IEEE standards may be allocated to three main classes:

1. Conceptual standards.
2. Prescriptive standards of conformance.
3. Guidance standards.

Conceptual standards

These set forth the guiding principles and overall approach to be applied.

Examples:

IEEE 610.12 – Glossary of Software Engineering Terminology

IEEE 1061 – Software Quality Metrics Methodology

IEEE 1320.2 – Conceptual Modelling Language, Syntax and Semantics for IDEF1X97

IEEE 1420.1a – Software Reuse, Data Model for Reuse Library Interoperability: Assets Certification Framework

IEEE/EIA 12207.0 – Information Technology Software Life Cycle Processes.

Prescriptive standards of conformance

These standards address the requirements to which a software developer must conform. A major portion of the standards collection belongs to this class.

Examples:

IEEE 828 – Software Configuration Plans

IEEE 829 – Software Test Documentation

IEEE 1012 – Software Verification and Validation

IEEE 1028 – Software Reviews

IEEE 1042.1 – Software Reuse – Model for Reuse Library Interoperability: Basic Interoperability Data Model (BIDM)

Guidance standards

These apply mainly to implementation of standard conformance requirements.

Examples:

IEEE 1233 – Guide for Developing System Requirement Specifications

IEEE/EIA 12207.1 – Guide, Information Technology – Software Life Cycle Processes – Life Cycle Data

IEEE/EIA 12207.2 – Guide, Information Technology

Exercise



Find information on the following standards,

1. An Example of a Conceptual standard: IEEE 12207-2008 - Systems and software engineering -
- Software life cycle processes
2. An Example of a Prescriptive standard: 1028-2008 - IEEE Standard for Software Reviews and
Audits