



A Comparative Study of ISO 9001, CMMI and Six Sigma with reference to Software Process Quality



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ABSTRACT

•Software quality is difficult to define because there is no single comprehensive and complete standard definition of its lexicon. The quality of software is difficult to accomplish as there is no definite way and not explicit necessities of each and every customer. The quality of any software is the measure of effectiveness and customer satisfaction. In present era, all software companies have a face up to make quality software within projected time and cost. The quality of software can be measured in terms of distinct phases of software development life cycle and after analyzing the each factor in term of parameters like cost/benefit analysis, reliability, customer satisfaction and many more. The better source of providing the quality may be a scale through which we can give quality to software but before proceeding standards a testing of software through different types is also an important task.

KEYWORDS

- Software
- Quality
- ISO 9001
- CMMI
- Six Sigma
- Software Process Quality

Introduction

The quality of software can be provided through various ways like-

- i. By Testing
- ii. By Inspection
- iii. By standard

The software testing is an integral part of each phase in SDLC to accomplish the quality. The testing is deployed to understand the requirements and to generate better quality code. Testing is overwhelming process for maintain the quality of the software, instead of using it inspection of code is time economy process has been decide on. The software quality through inspection can not be increased as this is not an effective to eradicate all bugs. The labor cost requisite is more in testing so it is more expensive. Today various organizations are adopting a variety of international standards for providing high quality software to their customers. These standards define process framework for a number of processes used in software development like designing coding testing etc.

Various major factors are defined to provide the quality but in this paper we are mainly concentrated on quality through standards.

In the next section of the paper we will define the quality of software, various international standards and their comparative study.

A Quality Software

Software quality ensures the correctness, performance and scalability according to the specification. A high quality software system can be achieved by providing quality in its development processes. The quality of software is a measure of various parameters which are as follows:

- **Customer satisfaction:** - Customer satisfaction from software is very essential to provide quality which may be in terms of user friendliness, completion of requirements.
- **Cost benefit analysis:** - The degree to which software accomplish the benefits according to the spend cost.
- **Bug free:** - The degree to which a software can work in user environment correctly.
- **Key Attributes:** - The degree to which software complete the non functional requirements such as reliability, accuracy, portability etc.

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- **Process Quality:** - During development process at each phase the quality of software should be measured.

These are some requirements which are needed for quality software. Every software needs some specific set of requirements which can be fulfilled according to that software process can be implemented. The quality of software varies according to the needs so at the time of planning, it should be well defined so that according to that needs the development of software can be completed.

Common problems to attain the quality- To maintain quality of software is more difficult than to develop software. Quality software should fulfill all the requirements to satisfy customer needs within estimated time and cost. There are some common problems which reduces the quality of software-

- ❖ **Poor definition of requirements** - Incomplete. Unclear and frequently changed requirements are accountable for lack of quality.
- ❖ **Poor Performance of system analyst-** The lack of expertise of analyst is responsible for the degradation of quality because of wrong estimation of time and cost.
- ❖ **Poor Testing-** Quality can be achieved if testing is made at all phases of the software development process extensively.
- ❖ **Poor Documentation-** Lack of practices of documentation tends to reduce quality of software because it makes difficult to maintain and modify the software.

Since these are some common problems, quality software can not be developed so there are certain standards which track planned and systematic approach to make quality software.

Various standards

Standards are needed to ensure certain attributes which makes the quality of software. The standards play an important role for any software evaluation.

A standard provides a medium that defines or represents the magnitude of a unit to help-

- ✓ A level through which allowable tolerances or constraints for categories of items,
- ✓ A degree or level of required excellence or attainment*

These international standards provide a process framework for the various processes of software development like coding designing and testing.

In this paper we will explain the effectiveness of following standards in software development.

- ✓ ISO 9000
- ✓ CMMI
- ✓ Six Sigma

ISO 9000 Standard:

ISO 9000 is a generic standard which provides a set of guidelines for the development process. It is not fully concentrate on product so it can be applied any kind of industries. It can be applied to manufacturing industries, service industries and also software industries. Since it is wide range standard so it is commonly used, easy used and cost effective. As quality consists of various parameters, ISO 9000 mainly focuses on customer satisfaction, data analysis and on continual improvement. ISO 9000 is a series of three standards

- ❖ **ISO 9001** - It is the quality assurance standard that applied to software engineering.
- ❖ **ISO 9002** - It is the quality standard applies to manufacturing industries like steel or car manufacturing industries.
- ❖ **ISO 9003** - It is the quality standard applies to the organizations involved only in installation and testing of the products.

Execution of ISO 9000 affects the entire organization right from the first state. If practice with total devotion, it results in 'intellectual evolution' to an environment of continuous improvement. The process of implementing ISO 9000 depends on various factors like-

- The complexity of existing quality program,
 - The volume of organization, and
 - The density of process.
- * ISO 9001

CMMI Standards - To advance the quality of software processes SEI (Software Engineering Institute) has developed a process maturity framework called Capability Maturity Model Integration (CMMI). This process model is an amalgamation of content of multiple streams consequently its integration. Development of any software as well as quality software requires process, people and technology to satisfy product cost, schedule and quality.

CMM Level	Focus	Key Process Area
Level 5 (Optimizing)	❖ Continuous Process Improvement	❖ Defect prevention ❖ Technology change management ❖ Process change management
Level 4 (Managed)	❖ Quantitative Management	❖ Quantitative process management ❖ Software quality management
Level 3 (Defined)	❖ Definition of processes	❖ Organization process focus ❖ Organization process definition ❖ Training program ❖ Integrated software management
Level 2 (Repeatable)	❖ Basic project management	❖ Requirement management

Table – 1: Capability Maturity Model Integration (CMMI) is a suite of

Products used for process improvement.

- Models
- Appraisal Methods
- Training Courses

CMMI provides the direction for valuable and competent improvement across multiple process restraint in the organization. It works on all elements of an organization to better development in each and every segment of organization.

Six Sigma-

Six sigma is named as sigma because it is used to deviate the value from standard values to improve the defects. Six sigma methodology is customer driven, quality management and quality improvement method which also measure the quality of process and product.

This methodology is based on understanding of customer requirement and customer satisfaction. The Six sigma is based on statistical concepts to improve the quality of business processes. The value of six sigma is used to measure the quality of product and processes. The sigma rating is calculated from the number of defects and number

of opportunities for defects to happen, where a defect is any variation from the desired target value.

Comparison of ISO, CMMI and Six Sigma

Criterion	ISO 9000	CMMI	Six Sigma
Developed By	ISO	SEI	Motorola
Focus	Product	Process	Product and process
Certification	External Agency	External Agency	Internal Control
Function	Defined Methodology	Defined Processes	Defined Values
Applicability	All types of industries	System Engineering	All industries
Approach	Quality Assurance Approach	Process improvement approach	DMAIC & DMADV approach
Technique Used	Qualitative Techniques	Quantitative Techniques	Statistical Techniques
Working	Reviews Entire quality management system	Reviews Overall process improvement	Reviews Only specific project/process
Limitation	Lacking in guidance to improve quality	Lacking in improvement through measurement	Lack of certified Authority
Position in quality hierarchy	Primary level	Middle level	High level

Table – 2: Comparison of ISO, CMMI and Six Sigma

In the previous section we have concentrated on brief introduction of all the three standards, in this section we will focus on comparative study of these three standards.

- ❖ **Developed By:** ISO 9001: 2000 standards is originated by ISO (international organization for standardization). ISO is a well known organization which provides

certificates to various type of organization for quality achievement.

- ❖ CMMI standard is originated by SEI (Software Engineering Institute) for the assessing the quality of software engineering processes.
- ❖ SIX Sigma methodologies are developed by Mikel J.Harry of Motorola to improve the quality by reducing defects.
- ❖ **Focus:** ISO 9001: 2000 standards are focused on the quality of product to make customer satisfaction.
- ❖ CMMI standards focused on the different processes of system development. Six sigma focused on product and as well as on process.
- ❖ **Certification:** ISO 9001:2000 and CMMI certification is approved by external authority. ISO and SEI are the certification authority to give the certificates of ISO 9001:2000 and CMMI respectively.
- ❖ Six sigma has no certifying body and therefore no organization can be termed as six sigma organization.
- ❖ **Function-**Working process of ISO is based on defined methodology. The CMMI standards functions on defining processes to develop software which works on customer satisfaction on the basis of schedule, cost and quality of product. Six sigma functioning is based on values to minimize the defects. In ISO& CMMI standard the quality is not dependent on business goals; in six sigma technique qualities is dependent on business goals.
- ❖ **Applicability** ISO 9001-2000 and Six sigma is applicable in all types of industries while CMMI works on system engineering.
- ❖ **Approach** ISO 9001-2000 approach is for quality assurance to improve quality of products, CMMI has process improvement approach and Six sigma has DMAIC (Define, Measure, Analyze, Improve and

Control) & DMADV (Define, Measure, Analyze, Design and Verify) approach.

- ❖ **Technique** 9000: 2000 standard is most common and economic **quality standard** so every organization can achieve it easily. CMMI standard works on **quantitative technique** while six sigma use **statistical technique**. The statistical definition of Six Sigma is 3.4 defects or failures per million opportunities.
- ❖ **Working** ISO reviews the entire quality management system; CMMI reviews the all processes of the organization, whereas six sigma focuses on specific projects and is designed to drill down into the process using analytical and statistical tools.
- ❖ **Limitation** ISO 9001:2000 basically works on whatever you have, you have to show that, but it do not concentrate on further improvement where quality is lacking so limitation of ISO 9001:2000 is in the guidance to improve quality
- ❖ **CMMI** works only on achieving maturity levels instead of quality improvement so organizations even reaching the maturity level are not fully satisfied because People using the new processes in most cases feel the improvement, while Management expects measurable contribution to a company's business objectives. Six sigma has no certification authority which can be used in any organization to named as a six sigma organization.
- ❖ **Position in quality hierarchy** ISO 9001:2000 has a position of primary level to assure quality as ISO 9001:2000 is equivalent to level 3 of CMMI; CMMI is middle level of achieving the quality because it goes beyond the quality assurance to approve the quality while six sigma is lies on high level as it is termed as world class performance.

Conclusion

The goal of software development organization is to improve the quality of software by defining and designing software processes which meets the

customer's requirements. The quality journey starts with the getting of ISO 9001:2000 .The ISO certified organizations can start implementing the process improvements defined in level 3 of SEI CMMI. After achieving this, they can implement the level 4 and 5 process improvement by using quantitative techniques. Finally, the quality is assured through six sigma by concentration on specific projects by working on particular software development process.

In this paper, we have studied all these three standards according to various parameters and also make their comparative study on various criteria.

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