ISO 9001 in software-developing VSEs assisted by the COMPETISOFT Model

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Abstract. A reconciliation between the COMPETISOFT software process improvement model and the international standard ISO 9001 is presented. The purpose of this reconciliation is analyzing the possibility that small software development businesses, assisted by the generation of the documents and the control of the activities defined with the COMPETISOFT Model, can obtain the ISO 9001 standard certification for Project Management and Software Development Processes.

Keywords: Software Engineering - Quality - VSEs - COMPETISOFT - ISO 9001

1 Introduction

This "certification" helps organizations have an objective assessment, and its advantages [1] can be summarized as follows:

- An increase in software development process productivity achieved by decreasing re-work and "non-quality" costs.
- An increase in competitiveness, since potential customers will choose the organization based on their preference for doing business with certified organizations.

The creation of a legal framework to promote the Software Industry in Argentina, created by Act 25,922, its regulatory decree 1504/04, and Resolution 61/05 of the Secretariat of Industries of the Argentine Republic, has strongly contributed to grow awareness in relation to "Software Quality". This legal framework allows enrolled organizations to obtain benefits, provided they meet all requirements, among them, having (Quality) improvement projects for their Software production processes [2].

Benefited by this legal framework that promotes the software industry, companies are growing their awareness and need to improve their software development processes. If this trend grows, it may affect mainly the volume of projects that can be carried out with the desired level of quality [2].

The standards and models whose use is established by the Software Promotion Act are:

- CMM
- CMMi
- IRAM-ISO 9001 - ISO/IEC 90003
- IRAM 17601 (CMMi (SEI))
- ISO/IEC 15504 (IRAM-ISO/IEC 15504)

From these, only CMMI and IRAM-ISO 9001 are currently valid and certifiable.

CMMi (Capability Maturity Model Integration) was created in the US and is widely used in that country, as well as in many other countries, especially information technology development areas, such as India and other emerging countries. It is specifically aimed at information technology organizations. The purpose of this model is the continuous improvement of process and product quality in the organization, and it provides guidance by defining maturity levels. Access to this model is difficult for our organizations because a high percentage of information technology businesses are VSEs and the application of the model involves a significant level of investment and preparation that these businesses cannot afford [1].

ISO 9000 standards are generally applicable to any industry or organization, that is, they are not specific to information technology organizations (they have been adapted to more than 90 countries and implemented in all types of industrial and services organizations). The ISO 9001 standard defines the requirements to obtain the certification [3].

This certification is more accessible for software developing VSEs because the required level of investment to obtain it is considerably reduced in relation to costs and time, which allows the organization to increase its production level and compete in international markets.

As mentioned before, the ISO 9001 standard is generic, so the ISO standards committee published the ISO 90003:2004 standard to provide guidelines for its interpretation for software processes. For the interpretation, the ISO 9001:2000 version is used, which was replaced by a new version in 2008. The application guidelines for software (ISO 90003) have not been updated yet, but the changes introduced are not substantial in this case. The ISO 90003 standard provides guidance to identify evidence, within the software process, to meet ISO 9001 requirements [4].

Based on all this, there are two issues to take into account to correctly apply the ISO 9001 standard to software development processes:

- The ISO 90003 standard is not based on the latest version of the standard.
- It only provides guidance for the organization.

COMPETISOFT proposes solutions for process and product quality assurance, and it offers the possibility of helping software developing VSEs to start their improvement process, in particular by means of COMPETISOFT's Basic Profile. This

model carries the organization through an improvement process in a staged manner, generating all the required documentation for a correct management of quality.

The idea of comparing COMPETISOFT's Improvement Model with the ISO 9001 Standard is based on all of the above.

The work group has experience in the application of the ISO 9001 Standard to the process of the pre-entry distance course of the School of Computer Science, which obtained its certification in March 2012. This application was implemented over a period of two years, during which each of the requirements of the Standard was thoroughly followed.

On the other hand, the team has a proven trajectory in the use of the COMPETISOFT Model after being part of its creation project and applying the Model to various organizations with good results.

Currently, the software processes of the Department of Medical Information Technology of Hospital Italiano de Buenos Aires are being diagnosed.

In the following sections, the models proposed by ISO 9001 and COMPETISOFT are described, followed by the reconciliation of both models to conclude, in Section 4, with the results obtained.

2 Process-oriented models

2.1 The ISO 9001 Standard

The first publication of the family of ISO 9000 standards dates back to 1987. They follow the ISO protocol that requires all standards to be reviewed at least every five years. The last review was in 2008 [3].

The family is basically formed by:

ISO 9000: Guidance and terminology.

ISO 9001: Requirements, it provides the requirements for obtaining the certification corresponding to quality systems aimed at external clients, including aspects such as design, manufacture, installation and maintenance.

ISO 9004: Guidance for continuous improvement, in general aimed at providing guidelines for the implementation of internal quality for the organization itself.

The ISO 9001 standard “Quality management systems — Requirements,” specifies the requirements for quality management systems that can be used internally by organizations, for the certification, or for contractual purposes. It focuses on the efficacy of the management system to comply with customer requirements. Since 2008, it promotes the adoption a process-based approach when developing, implementing and improving the efficacy of a quality management system in order to increase customer satisfaction by meeting customer requirements.

For an organization to operate efficiently, it has to determine and manage numerous interrelated activities. An activity or a set of activities that uses resources and is managed so that input elements can be transformed into results can be considered as a process. The application of a system of processes within the organization can be referred to as “process-based approach”.

One of the advantages of a process-based approach is the continuous control that it provides over the relations among the individual processes that form the system, such as their combination and interaction.

When this type of approach is used for a quality management system, the significance of the following is emphasized:

a) Understanding and meeting requirements
b) Considering processes in terms of the value they contribute
c) Obtaining process performance and efficacy results
d) Continuous improvement of processes based on objective metrics

2.2 The COMPETISOFT Model

COMPETISOFT is part of various process improvement proposals for small software organizations. Its purpose is increasing the competitiveness of software producing VSEs by creating and promoting a common methodological framework that, adapted to their specific needs, can become the basis upon which an assessment and certification mechanism can be established for the software industry that is accepted throughout Ibero-America. It is based on the model defined by MoProSoft, and it is very similar to the new ISO 29110 standard, not yet certifiable [5] [6].

The model has three process categories: Upper Management, Management and Operation, reflecting the structure of an organization. When the model was applied to software development organizations in the countries involved in the project, it was observed that it still took VSEs a long time to start the improvement process. For this reason, COMPETISOFT's Basic Profile was developed. This model was well accepted by the community researching in the quality area [7] [8].

In this paper, we focus on the Operation category, which contains three defined processes: Project Management (PM), Software Development (DEV) and Maintenance (MAI).

3 Comparing ISO 9001 and COMPETISOFT

Figure 1 shows a brief description comparing the documents from both models.

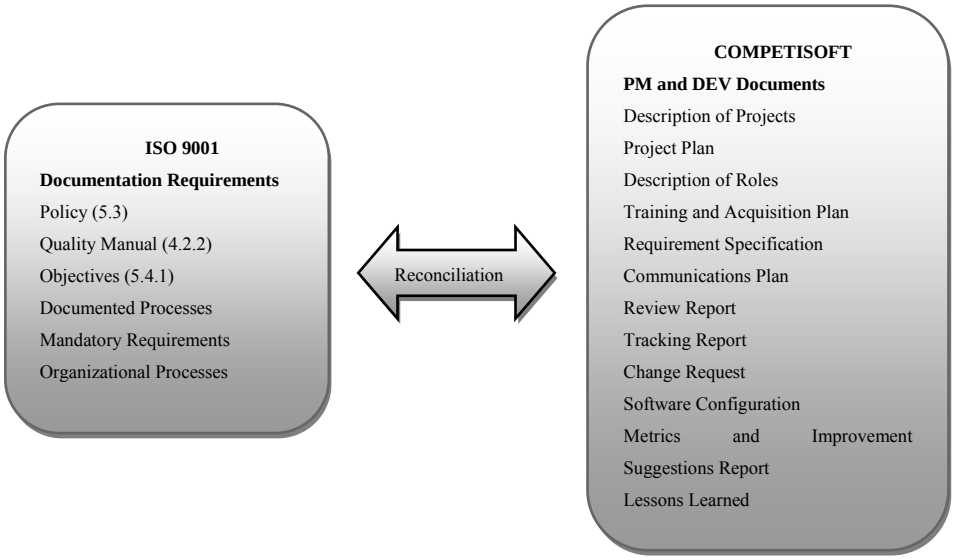

Fig. 1. Reconciliation of the models

The ISO 9001 certification requires that the Quality Manual complies with all the requirements detailed in the Standard and that all definitions included in the Manual are met, which must be demonstrated with recordable evidence.

The **Quality Management System** (QMS) is detailed as from section 4 of the Standard.

First, **General Requirements** are established (section 4.1 of the Standard); this section is part of the quality manual and any software company must describe the interaction with its own processes as well as those of the QMS.

The **Documentation Requirements** (section 4.2 of the Standard) section defines QMS documents, the Policy, Objectives, Quality Manual, Documented Procedures and Mandatory Records, in addition to the documentation that the organization considers necessary to provide the service or manufacture the product. Software companies should generate all QMS-related documents and those specific to the organization based on the considerations detailed in *Document Control Procedure*. The records that will be used as evidence that the process has been effectively implemented must be controlled as defined in *Record Control Procedure*. To meet documentation requirements, the ISO 90003 standard suggests using as records the

documents related to compliance with requirements, proofs of operation, retention and disposition. The documents that are generated as established by COMPETISOFT will be valid as evidence.

As regards **Management Responsibilities** (section 5 of the Standard), the only reference that the ISO 90003 standard makes to software organizations is in relation to **QMS Planning** (5.4.2), which mentions that planning must match the development life cycle and work documents must be defined. COMPETISOFT provides information for section 5.5.1 (**Responsibility and Authority**) with the description of role competencies, and for section 5.5.3 (**Internal Communication**) by establishing that a *Communications Plan* must be defined.

Under **Resource Management** (6), subsection 6.2 (**Human Resources)**, COMPETISOFT offers a *Role Description* and a *Training Plan* as evidence. In section 6.3, **Infrastructure**, the ISO 90003 standard mentions the equipment, development tools, connection infrastructure (network, Internet, firewall, etc.), product licenses, etc. These items are also covered by the *Acquisitions Plan* in COMPETISOFT. The ISO 90003 standard does not provide any interpretation regarding section 6.4, **Work Environment**. It can be defined in the Quality Manual directly.

Product Manufacture (7), or service provision, is the most important aspect when comparing the ISO 9001 and COMPETISOFT, since this is where the planning, design, and development process is described. Table 1 details each item in section 7 of the Standard and their match in COMPETISOFT based on the interpretation of the Standard suggested by ISO 90003. Each item can be achieved with COMPETISOFT, in some cases through the documents established by COMPETISOFT, and in others by means of a combination of QMS documents and COMPETISOFT documents. On the other hand, some of the items correspond to QMS.

# ISO 9001		Origin	Document	PM	DEV
7.1	Planning product manufacture	QMS/COMPETISOFT	Project Description - Project Plan	2	
7.2	Customer-Related Processes	QMS/COMPETISOFT	Project Plan,		
7.2.1	Definition of product-related requirements	COMPETISOFT	Requirement Specification	1	3
7.2.2	Revision of product-related requirements	COMPETISOFT	Project Plan,	3	3
7.2.3	communication with the customer	COMPETISOFT	Communications Plan	2	1
7.3	Design and development	QMS			
7.3.1	Design and development planning	COMPETISOFT	Project Description - Project Plan	8	5
7.3.2	Input elements for design and development	COMPETISOFT	Description of the Project	1	
7.3.3	Design and development results	COMPETISOFT	Project Plan - Requirement Specification	5	7
7.3.4	Design and development review	COMPETISOFT	Review Report	3	1
7.3.5	Design and development verification	COMPETISOFT	Project Plan	2	21

7.3.6	Design and development validation	COMPETISOFT	Project Plan	2	7
7.3.7	Design and development changes control	COMPETISOFT	Change Request	1	
7.4	Purchases	QMS			
7.4.1	Purchase process	QMS/COMPETISOFT	Acquisitions Plan	1	
7.4.2	Purchases information	COMPETISOFT	Project Plan, Acquisitions Plan	3	
7.4.3	Verification of products purchased	COMPETISOFT	Project Plan, Acquisitions Plan	1	
7.5	Service production and provision	QMS			
7.5.1	Production control and service provision control	COMPETISOFT	Project Plan, Activity Reports, Acquisitions Plan	9	42
7.5.2	Validation of production processes and service provision processes	COMPETISOFT	Review Report	1	3
7.5.3	Identification and traceability	COMPETISOFT	Software configuration	1	
7.5.4	Customer property	QMS	Requirement Specification		2
7.5.5	Product preservation	COMPETISOFT	Project Plan, Repository	3	
7.6	Tracking and measurement equipment control	QMS			

Table 1 Activities and documents used as evidence for ISO 9001

The evidence of **Planning product manufacture** (7.1) is obtained from the document *Project Description - Project Plan* that is maintained by two activities of the Project Management (PM) process. For **Customer-Related Processes** (7.2), it is obtained from the *Project Plan*, *Requirement Specification* and *Communications Plan* documents that are related to a total of 6 activities of the PM process and 7 of the Software Development (DEV) process. **Design and Development** (7.3) is achieved through *Description of the Project, Project Plan, Requirement Specification, Review Report* and *Change Request* generated and maintained by 7 PM activities and 42 DEV activities. **Purchases** (7.4) is related to 5 PM activities and recorded in documents from *Project Plan and Acquisitions Plan.* **Service production and provision** (7.5) is documented better by COMPETISOFT through the *Project Plan*, *Activity Reports, Acquisitions Plan, Review Report, Software Configuration* and the *Repository,* managed by a total of 14 PM activities and 45 DEV activities.

Service provision and measurement (8) is mainly linked to ISO 9001, but COMPETISOFT provides a lot of information for the sections on **Tracking and measurement** (8.2) by means of documents *Tracking Report and Acceptance Documents,* and **Data Analysis** (8.4) by adding documents *Metrics and Improvement Suggestions Report and Lessons Learned*.

Documented Procedures and Mandatory Records.

In section 4.2.1, mandatory documents are defined and documented procedures and mandatory records are mentioned. The Standard requires 6 documented procedures and 19 mandatory records. The documented procedures are more in relation to the QMS than software processes, since they detail and regulate their operation. The mandatory records correspond to sections 5.6.1, 6.2.2, 7.1, 7.2.2, 7.3.2, 7.3.4, 7.3.5, 7.3.6, 7.3.7, 7.4.1, 7.5.2, 7.5.3, 7.5.4, 7.6, 8.2.2 ,8.2.4, 8.3, 8.5.2, 8.5.3. Most of the records corresponding to section 7 are covered by the documentation generated by COMPETISOFT, which would also provide information regarding sections 6.2.2 and 8.2.4. The remaining records are related to managing the QMS itself. Table 2 details the relationship between the mandatory records and the documents that provide the evidence.

#	Mandatory Records, ISO 9001		Origin	Documents
1	5.6.1	Review by Management	QMS	
2	6.2.2	Qualification, Training, Awareness	QMS/COMPETISOFT	Description of Roles - Training Plan
3	7.1	Planning product manufacture	COMPETISOFT	Project Description - Project Plan
4	7.2.2	Revision of product-related requirements	COMPETISOFT	Project Plan,
5	7.3.2	Input elements for design and development	COMPETISOFT	Description of the Project
6	7.3.4	Design and development review	COMPETISOFT	Review Report
7	7.3.5	Design and development verification	COMPETISOFT	Project Plan
8	7.3.6	Design and development validation	COMPETISOFT	Project Plan
9	7.3.7	Design and development changes control	COMPETISOFT	Change Request
10	7.4.1	Purchase process	COMPETISOFT	Acquisitions Plan
11	7.5.2	Validation of production processes and service provision processes	COMPETISOFT	Review Report
12	7.5.3	Identification and traceability	COMPETISOFT	Configuration Management
13	7.5.4	Customer property	QMS	
14	7.6	Tracking and measurement equipment control	QMS	
15	8.2.2	Internal Audit	QMS	
16	8.2.4	Product tracking and measurement	QMS/COMPETISOFT	Tracking Report
17	8.3	Non-compliant product control	QMS	
18	8.5.2	Corrective actions	QMS	
19	8.5.3	Preventive actions	QMS	

Table 2. Mandatory records in ISO 9001 and their relation to COMPETISOFT documents

4 Conclusions and future work

A view of the ISO 9001 standard was presented with the guidelines for its application to the software development process as interpreted by ISO 90003. On the other hand,

the document generated by the COMPETISOFT model and the activities that manage them were analyzed in detail.

From this analysis, it can be concluded that COMPETISOFT would generate all the necessary documents to comply with the requirements of section **Product Manufacture** (7) and that it would provide information to cover the requirements described in sections 5, 6 and 8. Therefore, COMPETISOFT would be a good tool to introduce software organizations to the improvement process needed to achieve an ISO 9001 certification.

We continue to analyze improvement models and helping organizations that want to optimize their processes. In particular, organizations that are using the COMPETISOFT model to achieve this goal and are interested in obtaining a certification, such as Hospital Italiano de Buenos Aires. On the other hand, assistance is offered to software VSEs from the "La Plata Information Technology Development Area" that are interested in benefiting from the software promotion act.

5 References

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