A Modeling of Software Quality Management Base ISO 9001 *

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ABSTRACT

The software crisis haven't been handled completely after its appearing 30 years ago. Why is it? Many scientists and enterprises consider that the lack of the formal, effective technology and method of software quality management is the primary reason. The total quality management has become a integrated theory with the developing of the socialization production. Many international standard and industry standard has been made. This paper analysis the state of Chinese software industry and build the modeling of software quality management base ISO 9001 [1] and its realize framework.

Keywords: Software Quality Assurance, Software Quality Management, Software Engineering, ISO9000, CMM

1.   INTRODUCTION

After 70's years, the Academia and Industry of computer speed many people, money and time to research the software engineer environment, tools, and technology against the software crisis. Although they gained many achievement, but we have not seen the expecting result as yet. In fact, any new technology cannot be applied really without good management. Just in China, we developed and purchased many software supporting tools and environment. The cost over billions. But the Chinese software industry has not reached its aspiring level. That is why we want to setup a modeling and system of software quality management .It is proved that the guideline of the quality system for software processes has the same discipline even if   the software processes maybe difference because its hardware platform and applied domain is difference.

Nowadays, the size, complexity and cost of software increased rapidly. The role of software plays in system reliability and security become more and more important, the need of asking software production processes standardization, normalize and internationalization is more and more.   The technology for software processes management and control was focused. Many popular and important international or industry standard was put force. ISO 9000 and CMM [2] are the representation of them.

2.   CHINESE SOFTWARE INDUSTRY OVERVIEW

Software industry is a new one in China with only about sixteen years history. In addition, China is a developing country and is carrying out the socialistic market economy in stead of the planned economy with more than thirty years history. Many old rules in the planned economy times for quality management, control and surveillance are not suitable, so it's quite urgent and necessary to set up an effective quality system for Chinese software industry based on the current practice throughout the world.

Started from 1982, the Chinese software industry has snowballed since the beginning of the decade. In 1990, the total sales volume of software industry in China amounted to only 220 millions Chinese yuan. Nine years later, that figure had increased by a factor of 80 and sales in 1999 amounted to 17.6 billions Chinese yuan (about 2.1 billion US dollars), up nearly 27.5% on the previous year.

Meanwhile the Chinese software industry is still in the infant stage and remains dominated by small and medium-sized enterprises. Five hundred thousands people are engaged in software exploration in China. Fifty-five percent of the 20,000 software companies and related enterprises employ less than 50 staff. Only two or three enterprises have a staff of more than 1,000 people. In addition, only about ten enterprises have a sales volume of more than 100 millions Chinese yuan.

China government pays more attention to develop the software industry recent years. Some benefit policies to promote the software industry have been issued. Some large software companies and combined base has growth up. Chinese software industry is in a period of developing rapidly.

To support this developing, the quality management and control was focused. The basic installation such as the organization of ISO 9000 Quality certification, the normal management of ISO9000 assessor has been setup and improved. At the same time, the technology of software quality assurance is researched. That will help the software enterprise setup their quality system, improve their software processes and increase their productivity.

3. ISO9000 AND CMM

ISO9000

ISO 9000 family international standard is used to setup quality system for enterprise. The ISO definition of quality is "the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs" [3]. Also, an influential definition is perceived in various domains, including philosophy, economics, marketing, and operations management, i.e., quality is a complex and multifaceted concept that can be described from five different perspectives [4]: the transcendental view sees quality as something that can be recognized but not defined; the user view sees quality as fitness for purpose; the manufacturing view sees quality as conformance to specification; the product view sees quality as tied to inherent characteristics of the product; the value-based view sees quality as dependent on the amount a customer is willing to pay for it.

The Object of ISO 9000 is a) Accepted by industry at large; b) Correspond with current technology; c) Suitable the developing of future technology. After 1987, ISO 9000 family standard was issued firstly. It has formed the system of quality management and quality assurance. ISO 9000 was accepted widely in the world. The first object has been realized. This trend lead to many enterprises want to go into international market must consider whether or not they should adopt this standard. At same time, many countries transfer ISO 9000 into native standard identically. China made GB/T 19000-1994 [5] adopted ISO 9000 identically in 1992.

In ISO 9000 family, ISO 9001 is a standard suit for software development and maintenance. ISO 9001 describes many important process-quality attributes such as quality policy, strategic planning, resource allocation, quality planning, quality control, and quality assurance. In the 1994 version of ISO 9001, there are twenty attributes: management responsibility, quality system, contract review, design control, document control, purchasing, purchaser-supplied product, product identification and traceability, process control, inspection and test, control of inspection, measure and test installations, inspection and test status, control of nonconforming product, corrective and preventive actions, transportation, storage, package, protection and delivery, quality record, internal quality audits, training, services, and statistical techniques. These attributes describe a quality system. In addition, ISO 9000-3 [6] provide a guideline for software enterprise adopt ISO 9001.

Nowadays, Chinese quality audits has connected to international quality audits. Chinese quality audit organizations, the State Quality Certification Committee, formally joined IAF/MLA on January 22, 1998. Software companies will get acknowledgement from other member countries after passing audits in China.

CMM and SPICE

The CMM (Capability Maturity Model) differentiates among five levels of software-process maturity: initial, repeatable, defined, managed, and optimizing. For each level, it defines key process areas, with each area containing key practices that must be performed to rate that particular maturity level. A key practice specifies key indicators, which directly relate to at least one question. Thus, while the CMM provides useful guidelines for any organization wanting to find out what has to be done to reach the next maturity level, its use of a single maturity measure for an entire process does not sufficiently support a quantitative analysis of all a process's strengths and weaknesses.

The principles of the CMM have been included in an international collaborative project called Software Process Improvement Capability Determination (SPICE). SPICE was formed to develop an ISO standard for software process assessment. SPICE incorporates the intent of ISO9000 to provide confidence in a supplier's quality management while providing acquirers with a framework for assessing that potential suppliers have the capability to meet their needs in a comparable and repeatable way. SPICE is currently undergoing international user trials and evaluation [7].

4. The MODELING OF SOFTWARE QUALITY MANAGEMENT BASE ISO 9001

Along with the developing of software quality management and certification in Chinese IT industry, the relative supporting technology and tools was focused. How to help the manager and engineer of IT enterprise to understand ISO 9000 and CMM, introduce them establish the normal production processes and management processes, and provide the management and control of these work processes and documents? All of them are the important problems need to be solved urgently in Chinese software industry today.

Upon the modern quality management theory, the quality system is not just assure and maintain the quality, it must also has the ability to

improve its processes continuously. It is a dynamic system and focused on the process improvement.

ISO 9000 is focused to assess the product quality and quality system. CMM is focused to evaluate the maturity of production processes and pop out the continuous improvement. Distinctly, processes are improved continuously, ability is enhanced along with, the achievement of new technology applied is outstanding, The quality of products will be heighten and assured more and more.

CMM and ISO 9001 are not separate or conflictive [8]. Every quality character of ISO 9001 can be mapped to key process area [9] of CMM 2 or 3 level. They can be complemented. This modeling will refer ISO 9001 and CMM synthetically and setup the quality system. The goal of this modeling is help software enterprises setup their quality system conform to ISO 9001 or CMM. As the state of Chinese software industry current, the ISO 9001 certification can be accepted by many enterprises. In contrast, CMM certification is not accepted largely because its expensive cost and other difficulty. So, this modeling is focused on the establishing and management of the quality system base ISO 9001.

Anyway, ISO 9000 is a fruit of quality management in manufacture. How to induce ISO 9000 in software industry has some difficulty either in understanding or in carrying out. This modeling want to provide a technical supporting and platform for software enterprise do that. The primary functions of this model as followed:
a) Helping software enterprises setup the quality system, include quality policy, quality manual and procedure, etc.
b) Establishing the standard processes at organization level
c) Defining the software engineering processes upon the project and the life cycle modeling used to develop it. Emphasizing the design control (item 4.4 of ISO 9001)
d) Establishing the processes database of organization. Collecting and analysing this data. Providing the fundament for processes improvement and assessment.
e) Establishing the powerful configuration management system for managing the process products and ultimate products

Figure 1 gives an illustration.

Definition and Description of software processes
The kernel of modern quality management is process management. As the definition of ISO 9000, process is a set of relative resources and activates transform input to output. In software organization, the processes are divided into two classes, one is the management process, the other is software engineering process. Generally, the management processes at the organization level. Such as internal quality audit, training, review, suppliers evaluate and so on. The software engineering processes at the project level, such as requirement analysis, designing, coding and test. Some processes are only one activity. Others maybe a set of discrete activities. All of these activities exist some time order or predication relation each other. Here, we care about the management of processes rather than the process method. We use a template to describe the process and their relationship. It include:
 a) Responsibility: describing the function of process
 b) Attribute: describing the resource of process need, such as members, time, facility, method and support tools.
 c) Pre-condition: describing the activate condition and input
 d) Products: describing the result of process
 e) Postposition: describing the permit successive activities and the routing condition.

Definition and Management of Processes Database
Processes data and products are the assets of organization. They must assess and improve the processes by it. The processes database must manage information as below:
 a) All of the plan.
 b) All of the executive information about plan, such as status, real data and evaluation.
 c) All of quality records.
 d) All of the statistic information about software processes.

Management of Processes Flow
Processes flow means processes and its relationship. It is the embodying of quality management system. As a economical entity, enterprises must support and make its every business activity works in turn. Management the processes flow, control every role and its authority automatically by this modeling and realize tools, is the key tache of quality assurance. The processes flow must conform the quality system the organization adopted, and meet the business objects and environment of organization.

The active driving of processes flow is a important feature of this modeling. Most of the activities can be activated actively upon the plan, pre-condition and time order. This mechanism can inform everybody to do their work timely. It is very important to heighten the efficiency, especially for the manager every level.

Management of Document Flow

Documents, especially software engineering documents, are the important things tied software life cycle. So the management and control of documents is very important for the quality system. Here the documents are universality. They include:

a)   The policy and institution of organization
b)   Quality manual , procedure file and guideline of quality system
c)   All of the products of processes, include software engineering documents, review reports, test reports etc.

Documents are assets and fruits of organization. There are two goals at documents management. One is easy to use for software engineer and manager, increasing their efficiency. The another is to setup the security mechanism, prevent the secret from go outside, the fruits from run out. The management of documents flow integrates the configuration management, products identifying and tracing, documents control and quality records.
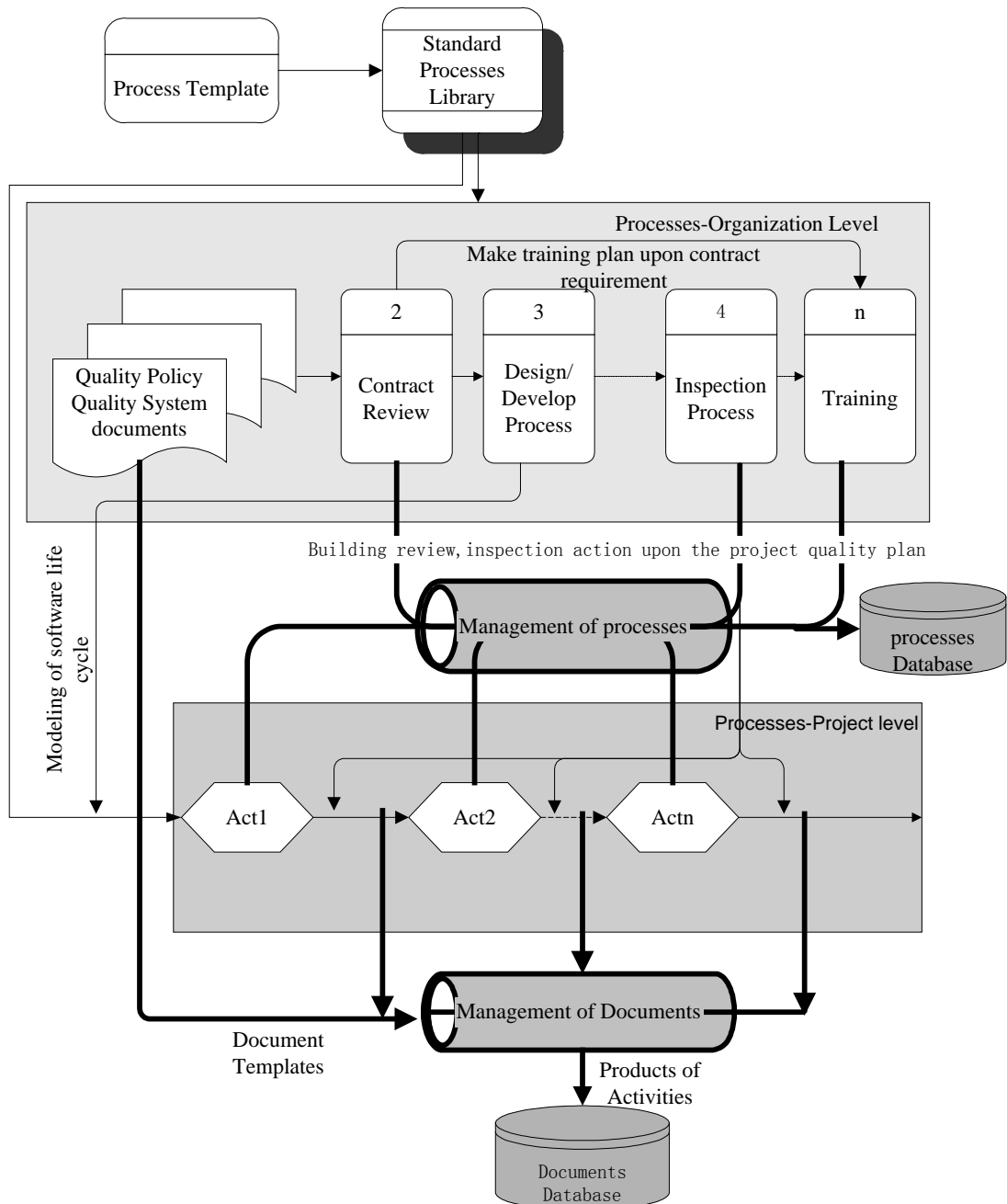
Figure 1： A typical quality management system based on ISO 9001

5.   CONCLUSION

The software quality management and assurance will be improved accompanying with the development of Chinese software industry. Carrying out ISO 9001 quality audits in software companies will be helpful to improve the quality management. The key problem is how to promote overall development of software companies by transforming quality audits into the motive force of companies.

6.   REFERENCES

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