◆ Application Paper

A Study on Quality Management and Assessment Model for System-Integration Organization

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ABSTRACT

Most of customers want to know how to develop the computer system they want to get to use according to the their requirements. This study presents a Computer Integration management System for Quality (CISQ) model for system-integration organizations, which need to demonstrate their capability to consistently provide computer integrated system that meets customer satisfaction and applicable regulatory requirements.

The Plan.Do.Check.Act(PDCA) cycle called by Deming wheel expresses the basic concept of continuous improvement action in order to emphasize on achieving business goal. It is useful for providing full competence of a system-integration organization to integrate management systems based on the international management system, and to take an advantage in its market. This study specifies International Certification Network Business Excellence Concept(IBEC) approach to ensure a harmonized integration of the variety of management systems and thereby produce synergy effect. The end part of this study specifies a Assessment Model including an assessment concept adding to the compliance audit according to the CISQ for the continuous improvement. A simple application on Failure Modes and Effects Analysis(FMEA) in testing phase in project life cycle has been done.

1. INTRODUCTION

This study specifies processes for a CISQ where a system-integration organization needs to demonstrate its ability to consistently provide computer system and aims to enhance customer satisfaction through the effective application of the system, continual improvement of the system and the output assurance to customer and applicable regulatory requirements. And it specifies point of view for an assessment on CISQ in order to support for operating effectively management system of a system-integration organization. A study is

how to establish and apply the requirements of CISQ where design, development, installation and maintenance of computer integrated system are an element of the business of an organization :

    a) As part of a commercial contract with an external organization;

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b) As a product available for a market sector;

c) In support of the business process of the supplier; and

d) As software embedded in a hardware product.

2. STUDY OF QUALITY MANAGEMENT MODEL

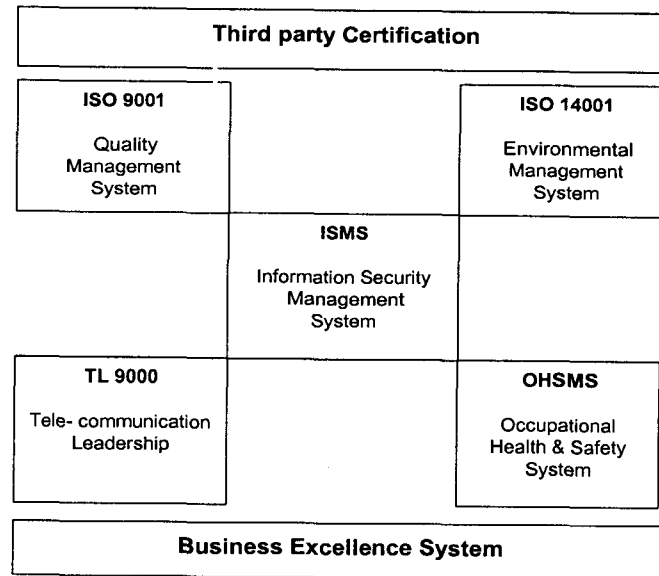## 2.1 International Management System Model

The quality management principles can be used by management level as a framework to guide their organizations towards improved performance. The nature of the organization and the specific challenges it faces will determine how to implement them. The eight Quality Management Principles are: *Customer focus, Leadership, Involvement of people, Process approach, System approach to management, Continual improvement, Factual approach to decision making, and Mutually beneficial supplier relationships.*

Various ISO Management Systems may influence positively the future development and improvement of system-integration organizations management system. After establishing and implementing quality management system(ISO 9001), system-integration organization should take account of establishing environment management system(ISO 14001), information security management system(ISMS), occupational health and safety management system(OHSMS) and telecommunication leadership management system(TL 9000) if it has project related to communication project for service provider or supplier of that industry.

2.2 Business Excellence System

The excellence models approach ensures a harmonized integration of the variety of management systems and thereby produces synergy effect. The main purpose of IBEC is to provide organizations with a business excellence assessment service and a self-assessment tool connected to conformance audits according to ISO 9001, ISO 14001 or any other vital management system standard. IBEC assessment services should help IQNet registered organizations to achieve and sustain superior performance by focusing on the following five key elements :

1. Appropriate integration of different management systems by applying a framework of organizational development.

2. Operational effectiveness through process management and continuous improvement.

3. Strategic alignment of activities within the organization.

4. Result orientation and balanced stakeholder-ship.

5. Value innovation for stakeholders of the organization.

Third party Certification		
ISO 9001 Quality Management System		**ISO 14001** Environmental Management System
	ISMS Information Security Management System	
TL 9000 Tele- communication Leadership		**OHSMS** Occupational Health & Safety System
Business Excellence System		

[Figure 2.1]   Integration Management System of SI organization

3. COMPUTER INTEGRATION MANAGEMENT SYSTEM   FOR QUALITY   (CISQ)

3.1 Understanding of Quality policy

The CISQ can help top management of the system-integration organization to establish, document, implement and maintain its quality management system and continually to improve its effectiveness in accordance with the customer requirements. An organization's quality policy should be an equal and consistent part of the organizations overall policies and strategy.

| quality policy	top management	management representative	manager of quality management dept.	total
writer	15 %	15 %	70 %	100 %
understanding degree	0.56	0.45	0.29	0.36

[Table 3.1]   Relationship between writer and understanding of quality policy

Table 3.1 shows quality consistency as a relationship between the understanding degree on quality policy of employees and the level of writer of quality policy. This is a result of survey on 20 big system-integration organizations which the number of employees are over 300 in Korea. The result of survey shows that the quality consistency index is 0.36. It means the understanding degree on quality policy is very low.

3.2 Major processes on CISQ

This study specifies requirements for the CISQ as shown Figure 3.1. The following **major**

processes on CISQ should be set out in the quality planning of the system-integration organization:

Act   Plan

Check   Do
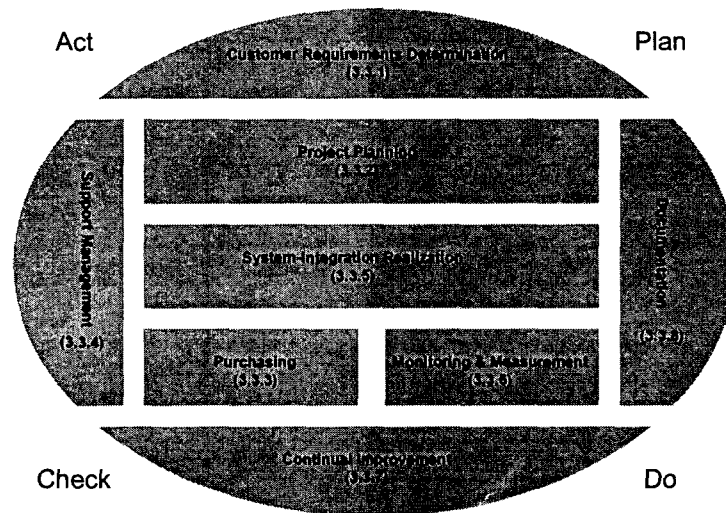
[Figure 3.1] CISQ Model

3.2.1 Process of Customer Requirements Determination

A system-integration organization should determine requirements specified by the customer, including the requirements for delivery and post-delivery maintenance, requirements not stated by the customer but necessary for specified. The following processes should be determined: *Process of contracting; Process of customer requirements review; and Process of communication with customer.*

3.2.2 Process of Project Planning

The integrity of the project management system including the quality objectives can be established as a planning of project for system-integration realization and/or a planning of support management of it. A system-integration organization should determine the following processes, as appropriate way in the process of project planning as shown Figure 3.2: *Time related process; Cost related process; and Resource related process.*

The project realization planning (PRP) must be dependent on project lead time, budget and resources, the organization should establish internal communication process in order to facilitate the exchange of information necessary for the project. The project planning should be base for **project realization planning.**

PRP Circle : Project Realization Planning
based on continuous improvement
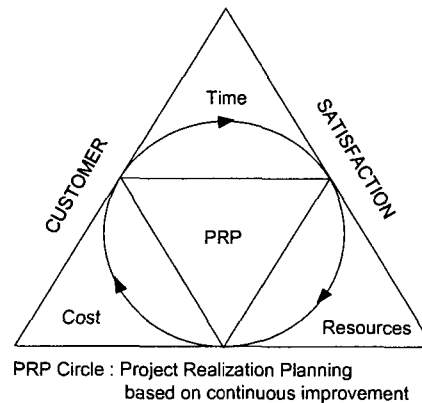
[Figure 3.2] Project Planning Triangle

3.2.3 Process of Purchasing

There are three types of purchasing ways in a system-integration organization as
followings:

- Outsourcing to supplier for integration of a part of computer system or software
  development or networking;
- Subcontracting with supplier for provision of qualified persons; and
- Buying stand-alone hardware or software package from market.

The following processes should be determined: *Process of obtaining purchasing
information; Process of purchased computer system verification; and Process of suppliers
evaluation.*

3.2.4 Process of Support Management

The following processes should be determined: *Process of customer property control;
Process of preservation of hardware and software; and Process of monitoring and
measuring devices control.*

3.2.5 Process of System-Integration Realization

Planning of project realization should be consistent with the requirements of the other
processes of the CISQ. Where a proprietary software development methodology is used, it
should be linked with the quality manual. The following 10 **key processes for project
realization** should be set out in the project performance plan for each project: *Process of
Project Realization Planning; Process of Configuration Management; Process of Output
Assurance; Process of Requirement Analysis; Process of Design; Process of Review;
Process of Risk Analysis; Process of Deployment; Process of Verification and Test; and
Process of Validation and Integration.*

3.2.6 Process of Monitoring and Measurement

The emphasis is on demonstrating conformity of the computer system and on the
effectiveness of the CISQ, even if the efficiency of the CISQ must be important for any

organization. The following processes should be determined: *Process of customer satisfaction survey; Process of internal audit; Process of monitoring and measurement of processes; Process of monitoring and measurement of product.*

3.2.7 Process of Continual Improvement

It is very important activity for continual improvement to set up process of noncompliance control and take corrective and preventive action. Any corrective or preventive action should be clear to spread to another project for benchmarking. In case changes need those should be documented and agreed with all relevant personnel before they are implemented. The following processes should be determined: *Process of nonconformities control; Process of analysis of data; Process of preventive action; and Process of corrective action.*

3.2.8 Process of Documentation

There must be a documented CISQ covering all the applicable processes for system-integration. It is important to note the difference between document control and record control. While the main purposes of document control are to define the controls needed to approve documents for adequacy prior to issue, to ensure that relevant version is available at the right place and at the right time in order to prevent the unintended use of obsolete documents, the main purposes of record control are for the identification, storage, protection, retrieval, retention time and disposal of records.

4. ESTABLISHMENT OF ASSESSMENT MODEL

4.1 Assessment Principles based on Business Process

When conducting the assessment for the system-integration organization, the auditors should consider following principles. The auditors should:

1. Have an interview with top management and management representative.
2. Identify the major processes of the organization to arrange the audit team and audit time as preparing the audit program.
3. Identify the key processes of department/project to audit the effectiveness of the processes of the organization.
4. Conduct an audit to be focused on the PDCA cycle of the processes in view of business objectives achievement.
5. Consider the effectiveness and the correlation between the processes audited.
6. Check feedback process among the PDCA cycle on site audit.
7. Evaluate constantly the effects of audit observation and personal interactions during an audit.
8. Preview it would contribute to the suitability, adequacy and effectiveness of the process as declaring nonconformity or area for improvement.
9. Take account of the scope and possibility of its corrective action prior to declare nonconformity.
10. Accept a correction of trivial human error during an audit.
11. Accept evidence without written records, however, any statement of an auditee should be identified whenever it becomes evidence.

12. Fill out audit report to be traceable for the content of nonconformity.

4.2 Assessment on CISQ

4.2.1 On-Site Assessment on CISQ

It is important that all the processes within the CISQ can be managed using a PDCA approach, with the emphasis on achieving planned results. This should be shown by: Responsibilities and authority defined and communicated within the organization; and Processes required for the CISQ and outputs at the each stage of project management with PDCA cycle. The on-site assessment should be focused on the cross- functional process instead of the each process in view of business goal achievement of the whole organization. During a compliance audit, it will still be necessary to get evidence whether the processes are being managed, but in many cases this could be in the form of data and records, without documented procedures.
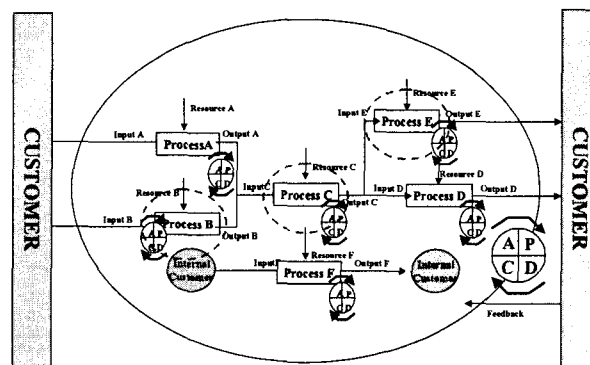
[Figure 4.1] Process network with PDCA scheme

4.2.2 Sampling

Among the multi-project sites that are operating on a temporary basis for the period of the system-integration projects, each stage of project life cycle should be grouped and submitted to the auditors for selecting audit sites. The auditors should select randomly at least one project site of each development stage in project life cycle, for instance customer requirement analysis stage, design stage, deployment stage and testing stage.

The following guidance is based on the example of a low to medium risk activity with less than 50 employees at each site.

Where x is the number of projects, then y should be the size of the sample.

- Initial audit: the size of the sample(y) should be the square root of the number of remote sites: (y= $\sqrt{x}$), rounded to the upper whole number.
- Surveillance visit: the size of the annual sample(y) should be the square root of the number of remote sites with 0.6 as a coefficient (y= 0.6 $\sqrt{x}$), rounded to the upper whole number.
- Reassessment: the size of the sample(y) should be the same as for an initial audit.

Nevertheless, where the quality system has proved to be efficient over a period of three years, the size of the sample(y) could be reduced by a factor 0.8, i.e.,: (y= 0.8 $\sqrt{x}$), rounded to the upper whole number.

· At least 25 % of the sample should be selected at random.

4.2.3 Failure Modes

According to supplemental requirement of TS 16949, the product design output shall be expressed in terms that can be verified and validated against product input requirements, and shall include design FMEA, reliability results, etc. FMEA could be also a systematic analytical technique for failures control in the process of system-integration realization. As mentioned in the process of nonconformities control, any failures should be defined in order to prevent reoccurrence. The sources of nonconformities are as followings:

· Detected problems in the process of software testing;
· Nonconforming hardware as incoming inspection;
· Discovered problems in the process of system-integration; and
· Human errors not to follow the procedures.

The modes of nonconformities detected during testing phase could be classified are as followings: Transaction errors (input, modification, deletion, inquiry); Output (print out); User interface; and Module interface.

4.2.4 Effects Analysis

The purpose for effects analysis is improvement every processes and minimizing human error based on business continuity. In order to elaborate an evaluation specification to satisfy some evaluation requirements, it is necessary to specify metrics. Metrics are based on evaluation techniques that may be chosen according to quality characteristics and evaluation levels. In the following is proposed, for each quality characteristics in ISO/IEC 9126, a list of evaluation techniques ranked from less demanding levels to more demanding levels: *Functionality; Reliability; Usability; Efficiency; Maintainability; and Portability.*

Wear or aging does not occur in software. Limitations in reliability are due to faults in requirements, design, and implementation. Failures due to these faults depend on the way the software product is used and the program options selected rather than on elapse time. The capability of the software product to maintain a specified level of performance when used under following conditions: *Maturity; Fault tolerance; Recoverability; and Compliance.*

4.3 Assessment on Business Excellence

The Business Excellence Assessment Model includes an assessment concept adding to the compliance audit according to the CISQ for the continuous improvement in the context of the business excellence model, MBNQA model. The CISQ requirements are assessed for compliance, but are at the same time seen in relation to the relevant business excellence model criteria for evaluation and identification of possibilities for improvement. For the IBEC evaluation scheme there is two directions, one is enabler evaluation and the other is results evaluation. The evaluation schemes for enablers are approach, deployment and strategic fit and results are excellence, scope and value innovation.

5. CONCLUSION AND FURTHER STUDIES

It is expected that an organization will adopt a PDCA approach to its processes with the emphasis on achieving planned results, and will incorporate feedback obtained from process controls, product evaluations and indications of customer satisfaction to improve its management system. And a study specifies point of view for an assessment on CISQ in order to operate effectively management system of a system-integration organization, and also directs integrated management to establish a Business Excellence Assessment Model.

The assessment checklists for ISO integrated management systems should be studied here after to provide verified and validated computer system against integrated management requirements, and including system-integration reliability for a system-integration organization based on ISO 9001, ISO 14001, ISMS, TL 9000 and OHSMS to take an advantage in its market. Not only combination of ISO management systems but IBEC model approach are going to be studied in the near future to ensure a harmonized integration of the variety of management systems. And FMEA must be a systematic analytical technique for any failures control in the process of system-integration realization. A study on FMEA in testing phase in project life cycle has been done, however, the manners in which the process could potentially fail are going to be studied to meet the every system development stage.

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