1. Introduction

Quality improvement has been an area of major development in the operations management area. One of the key ideas involved is that of continuous improvement – developing a philosophy of business in which the way work is done (processes) is continuously reviewed with the intent of improving it.

The emphasis on quality processes has been widely implemented in the US through the annual Baldrige Award competition, as well as the European Quality Award assessment model. In this topic, we will discuss two other programs, which have had a major impact in the software development industry, namely ISO 9000 (European standards for production and management processes) and the Software Engineering Institute's Capability Maturity Model.

The presentation below illustrates how development standards fit in the project management roadmap.

In the project planning and scheduling phase, the project manager is faced with the challenge of planning the project given the various resources, time and budget constraints. In addition, the development standards to be used on the project are also considered. In this topic, we will examine the various software development standards followed in the information systems (IS) industry.

Objectives: Software Development Standards

Upon completion of this topic, you should be able to

- explain the importance of software development standards on software quality
- describe international standards such as ISO 9000 and the Software Engineering Institute’s (SEI) Capability Maturity Model Integration (CMMI)

2. Total Quality Management (TQM)

Total quality management (TQM) is an attitude seeking to gain improvements in quality (be it manufacturing, services, organisational performance or other quality criteria in general). Criteria to attain total quality that have been proposed by those who sell TQM include measurement and customer focus.
It is important to measure output, whatever form that output takes, in order to gauge the attainment of quality.

It is important to understand client needs in order to expect an output of value.

Both these concepts are highly pertinent in IT quality software development. The principle of continuous improvement is also key to the attainment of higher quality. This reflects an attitude of always seeking to do a better job.

3. International Organization for Standardization (ISO)

The International Organization for Standardization (ISO) is a network of national standards institutes worldwide, working in partnership to bridge public and private sector emphasis on quality. ISO 9000 is a set of standards focusing on an organisation's processes rather than the quality of products these organisations produce. The philosophy is that if the processes of design, manufacturing, logistics and other managerial areas are followed correctly, they will yield quality goods.

The purpose of ISO 9000 standards is to ensure that processes can consistently meet customer expectations. The standards require that processes be defined and documented, action taken to ensure that these procedures are followed, processes are measured and recorded and continuous improvement is implemented. In the US, ISO registration is becoming more and more important as a qualification to do business, especially with military and other government agencies.

ISO 9000 introduces the following eight quality management principles.

1. **Customer focus**
   To expect to remain in business, organisations need to:
   - Satisfy current customer needs
   - Exceed their expectations
   - Anticipate their future needs

2. **Leadership**
   Leaders need to establish unity of purpose and organisational direction

3. **Involvement of people**
   People at all levels should be motivated and committed
4. **Process approach**  
Management of activities and resources are more efficient when managed as a process.

5. **System approach to management**  
Organisational effectiveness and efficiency require identifying, understanding and managing interrelated processes.

6. **Continual improvement**  
An organisation’s permanent objective needs to be continual improvement of overall performance.

7. **Factual approach to decision-making**  
Effective decision-making requires analysis of data and information.

8. **Mutually beneficial supplier relationships**  
Organisations are interdependent with their suppliers and each needs to contribute value to the other.

This focus on quality management is appropriate to all organisations. IS projects can be a valuable tool in implementing process improvement. For more information, you can view the [International Organization for Standardization](http://www.iso.org) website.

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**Zero defects through lean software development**

In recent years, lean software development has emerged as an approach to develop software of high quality. Software defects result in longer cycle times because of the time needed to fix problems. By significantly eliminating defects (to the point of zero defects), cycle times can be considerably shortened. One particular example of software development is Extreme Programming or XP. In XP, tests are written before the code (ie, you clearly know what you want the code to do or not to do) and testing is automated as much as possible. The software is also released in short cycles and on a frequent basis.

For more details about XP, you can access [Kent Beck’s](http://www.kentbeck.com) (the founder of XP) website.

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**4. Capability Maturity Model Integration (CMMI)**

Another common standard is the Capability Maturity Model Integration (CMMI). CMMI is an integration of software engineering Capability Maturity Model (CMM) and a number of other process engineering CMMs. Process capability is the ability of an organisation to follow disciplined processes and achieve expected outcomes. Process maturity relates to lucidity and effectiveness of process definition, measurement and control. A Capability Maturity Model defines the structure and levels of process capability and maturity that organisations can apply to measure their processes and improve their operations.

The CMMI model further contains three models each having the core 16 process areas. The three models are:
- [CMMI for Acquisition](http://www.cmmi.org)
- [CMMI for Development](http://www.cmmi.org)
- [CMMI for Services](http://www.cmmi.org)
There are 16 core process areas which are common to all the three models. In addition, there are unique process areas defined for individual of the three CMMI models.

CMMI provides the platform of an evolutionary path from ad hoc and unorganised activities to mature and disciplined practices. The model has two representations: staged and continuous. The staged representation has five maturity levels to assess an organisation's software process, namely, initial, managed, defined, quantitatively managed and optimizing.

At Level 1, an organisation uses ad hoc, possibly chaotic processes. A common feature of Level 1 organisations is that managerial decision-making is based on intuition and guesswork about the requirements to finish software projects. These organisations have been found to have the greatest number of project overruns in time and budget.

The continuous representation allows an organisation to select individual practices of different capability levels according to its business needs. Four capability levels defined by the model are: Incomplete, Performed, Managed and defined.

The following graph illustrates the expected impact of various CMMI levels.

Organisations should focus on using the CMMI model to achieve business objectives and solve real problems. The process improvement should start with identification of their organisational and project goals and problems through assessing their processes and operations against the capability maturity levels. It can then select elements from each process area that best help them move towards their goals and fix their problems. Action plans are to be drawn and implemented, to improve delivery of performance, quality, cost, and schedule.
Reading: Capability Maturity Model Integration (CMMI)

To have an overview of the model, read the following report:


Also, read the following:

5. Exercise

Click the link below for an exercise to practise applying the ISO 9000 quality management principles.

Exercise: ISO 9000 Quality Management Principles

Exercise: ISO 9000 Quality Management Principles

Alternate text

Exercise Alternate Text

Exercise

Q1. The IT programmers do not appear motivated or valued within the organisation. The project managers rarely consult them on projects, even though they often make very helpful suggestions.

Which one of the following ISO 9000's quality management principles would you apply?

1. Involvement of people
2. Process approach
3. Mutually beneficial supplier relationships
4. Customer focus

The correct answer is option 1, Involvement of people

Q2. Internal customers have been frustrated that the IT department has not followed up on the changes requested to the existing back-end systems. The IT department seems to be carrying out the changes it wants to do rather than the changes requested by the customers.

Which one of the following ISO 9000's quality management principles would you apply?

1. Involvement of people
2. Process approach
3. Mutually beneficial supplier relationships
4. Customer focus

The correct answer is option 4, Customer focus

Q3. Recently the hardware suppliers have been delivering hardware of the wrong specifications due to communication problems with the procurement division. This has led to some unnecessary friction. Which one of the following ISO 9000's quality management principles would you apply?
1. Involvement of people
2. Process approach
3. Mutually beneficial supplier relationships
4. Customer focus

The correct answer is
• option 3, Mutually beneficial supplier relationships

Q4. The project teams do not seem to be working effectively. This may be due to the increasing demands being placed on them to meet project deadlines and work overtime, thus having a detrimental effect on their overall productivity. Which one of the following ISO 9000's quality management principles would you apply?
1. Involvement of people
2. Process approach
3. Mutually beneficial supplier relationships
4. Customer focus

The correct answer is
• option 2, Process approach

6. Self-Assessment

Now, try the self-assessment questions to test your understanding of the topic. Click the following link to open the Self-Assessment in a new window.

Self-Assessment

Self-Assessment Alternate Text

Self-Assessment

Q1. Which one of the following defines ISO 9000?
1. It provides trade agreement rules assuring proper transfer of funds
2. It aims to do a job right the first time, thus eliminating the need for improvement
3. It encourages intuitive decision-making to speed the process
4. It encourages customer focus and involvement of people

The correct answer is
• option 4, It encourages customer focus and involvement of people

Q2. Which one of the following statements about the CMMI levels is true?
1. Level 1 represents the premier level of quality competence and is rarely attained
2. Level 5 is the highest level of attainment
3. As you move up levels, quality increases but at the price of increasing cost
4. As you move up the five levels, the number of defects encountered tends to increase

The correct answer is
Q3. Which one of the following describes the Capability Maturity Model Integration?

1. It consists of levels of project control attained through ISO 9000 training
2. It consists of improved efficiency in software development due to reduced documentation
3. It consists of the development of an organisational culture that leads to more systematic software development capabilities
4. It consists of an approach that leads to faster software project development on an average, but at a higher cost per project

The correct answer is

- option 3, It consists of the development of an organisational culture that leads to more systematic software development capabilities

7. Summary

This topic covered the following main points:

- Software development standards are aimed at improving quality levels within an organisation.
- ISO 9000 standards are European in origin and are required to do business with some European Union economies.
- In Japan and in the US, total quality management has been popular for some decades.
- Borrowing from manufacturing, lean software development and zero defects have emerged as approaches to software development.
- The Capability Maturity Model Integration (CMMI) is intended to improve the way organisations develop systems as a whole. CMMI is based on five levels, namely, initial, repeatable, defined, managed and optimising.