

QUALITY IN ENGINEERING EDUCATION : ISO 9000 PERSPECTIVE

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As a TQM/ ISO 9000 consultant, one of the questions that I have been asked is : What is the relevance of ISO 9000 Standards to education? This short article is an attempt to examine whether and how ISO 9000 Standards can be used to maintain and improve the quality in education.

What is Quality ?

Before we can examine the issue, however, it is necessary to arrive at a common understanding of the concept of quality. Quality means different things to different people as can be seen from the summary of the responses that I have got to the query : 'what is quality?' from participants of my various training programs on TQM / ISO 9000 :

- * Q is in the eye of the beholder
- * Q is value-added
- * Q is the proof of pudding
- * Q is the search for excellence
- * Q is a mark of excellence, persistent and maintained over a long period of time. Such excellence is a function of habits, culture and values, and may thus vary from person to person and from time to time;
- * "Faster, higher, stronger" - Olympic motto.

Even the quality gurus like Deming, Crosby, Juran, et al, have given different definitions emphasizing particular aspects of quality. It is therefore best to adopt the definition given in the ISO 8402 :

"Totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs"

'Entity' means that which can be individually described and considered. An entity may be, for example,

- an activity or a process
- a product
- an organization, a system or a person, or
- any combination thereof

It will be clear from the definition that quality is irrevocably linked to the customer. In fact, it is the customer who dictates quality. The definition is broad based and does not restrict itself to 'product' quality alone. The emphasis on the stated and implied needs covering a gamut of expectations of the customer from the entity. The needs in which the customer is interested may include, for example, usability, maintainability, reliability, response time, 'mtbf', robustness of design, delivery, service after sales, cost etc.

The Customer :

We would also do well to remember that 'customer' is one who is the recipient of the outcome / product of a process. It is important to note that customer could be the end user of a product / service or one who is a distributor / dealer. As any product / service generally will be the end outcome of a chain of processes, one could easily understand that the word customer

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is equally applicable to internal or external customer, depending on whether one is recipient of the outcome of a sub process or end process.

Approaches to Quality :

The traditional approaches to maintain quality are :

1. Quality Control (QC)
2. Quality Assurance (QA), which extends further to Total Quality Management (TQM)

The aim of Quality Control is to prevent a defective item being delivered to the customer and the approach typically lays much stress on inspection before delivery to the customer. On the other hand, Quality Assurance lays stress on product as well as the process so that quality is built into the design of the process itself and the process is well controlled by putting in place a system of periodic / continuous measurements at significant points along the process. This gives a certain degree of assurance that the output of the process would conform to laid down standards within allowable tolerances. Thus, the emphasis in quality assurance is futuristic unlike quality control. Quality assurance when extended to all business processes with total customer focus and commitment of the management is what the Total Quality Management is all about.

Thus it will be realized that process design and process control are the crux of quality assurance.

Those interested in ISO definitions of QC, QA and TQM may refer ISO 8402 : 1994.

ISO 9000 Series of Standards :

These standards were published by the International Organization for Standardization in 1987. These were revised in 1994 and a third thoroughly

revised version will be out soon. These standards prescribe a model for quality systems. The three main standard are listed below :

- * ISO 9001 : Quality Systems - Model for quality assurance in Design, Development, Production, Installation and Servicing;
- * ISO 9002 : Quality Systems-Model for quality assurance in Production, Installation and Servicing;
- * ISO 9003 : Quality Systems-Model for quality assurance in final inspection and testing.

It will be noted that these are distinct standards applicable to the organization depending on the activities that the organization is engaged in. They are like different syllabi for different graduate courses.

ISO 9001, which is the most extensive and stringently applied, has, in the current version, 20 *elements* or clauses that specify what needs to be addressed as a minimum requirement for the quality system to be certified as conforming to the Standard (henceforth 'Standard' would mean ISO 9001 : 1994). Managing of anything requires:

1. Policy statement of intention of what is to be achieved
2. Organization and allocation of resources
3. An organization structure/system
4. Documented processes and procedures for various activities
5. Training of the employees for effective job performance
6. Control mechanisms to ensure system implementation and continued effectiveness
7. Maintenance of records as evidence of the activities having been performed as per procedures as well as for

facilitating analysis for improvement of the system.

The 20 *elements* of the Standard together cover all these aspects. The Standard requires that documented procedures should be in place to ensure that these aspects are adequately addressed, that the procedures are actively implemented, that periodic audits of the quality system are done as a planned and systematic activity to ensure continued effectiveness of the quality system. It also mandates that any non-conformities found during the audits are expeditiously corrected, corrective action taken is re-audited for adequacy and effectiveness. The Standard requires that the top management is actively committed and hence the first of the twenty elements defines management's responsibility for quality. It requires the management to make a clear, documented quality policy statement and to make sure that the policy is '*understood, maintained and implemented*' at all levels of the organization. Further, it lays down that adequate resources are allocated and appropriate training provided to all those who *manage, perform and verify work, affecting quality*. There is also a mandate for management to periodically review the quality system for effectiveness. Other quality elements deal with the operational, control and support aspects. All in all, the twenty elements together provide a framework on which to fashion a quality system that assures a consistency in "product" quality.

How to maintain Quality in Education?

As we have discussed above, the best approach to assurance of quality is to look at the process, optimize it, and then control it. A process takes input and produces an output with added value. ISO

9001 : 1994, clause 4.9 deals with process control. Clause 4.14 deals with corrective and preventive action, whereas clause 4.17 provides for internal audits of the quality system. It is not proposed to discuss these clauses *per se* in this short article. Allusion to these clauses is meant to show that the ISO 9000 standards give a useful, commonsense framework for the organizations to shape their quality management systems to instill confidence in themselves and the customers regarding the organization's ability to constantly deliver quality to the customer.

The first step in our quest to quality in engineering education is to decide who is or are our customers, both internal and external. Do we know the customers? Do we know their needs? Are the needs specified or implied?

Having identified the customers and their needs, the next step is to look at the process to meet the needs of the customers. Some of the inputs to the education process can be easily identified.

- * Research;
- * Curricula;
- * Staff Members;
- * Students;
- * Infrastructure;
- * Environment and culture of the educational institution;
- * Methodology of teaching;
- * Tests / Examinations;
- * Process evaluation;
- * Regular feedback from present and past students, teachers, and the employers.

Each of these inputs has to be carefully examined and standard policies and procedures laid down and executed in a planned way. Periodic checks have to be

institutionalized and carried out to ensure reliability and effectiveness.

The process that we have considered is macro process, most of the inputs of which are the sub processes themselves. The quality of the output of the entire process will be affected by the operation of any of the sub processes, for example, research, or examinations. It is not possible to discuss all the elements of ISO 9001 in this short article. The above discussion of just one element 'process control' would suffice to get an idea of the relevance of ISO 9000 series of standards for maintaining the quality of engineering education. The standard provides a framework on which one can design one's quality system.

Ten - Step Action Plan :

Let us now see the steps that need to be taken :

1. Set up an Apex level Quality Steering Committee / Quality Council
2. Appoint a Quality System Coordinator. This person should be a knowledgeable well respected, senior level person who has been vested with adequate organizational authority to clear any bottlenecks that may be found on the way to establishing and maintaining the quality system.
3. Arrange ISO 9000 presentation for top level management / faculty
4. Get the consensus decision made to establish the system to conform to ISO 9000
5. Expose the other faculty members and all concerned to ISO 9000 standards through Awareness Programmes
6. Form a core group to create the necessary documentation of the quality system as per the

requirements of ISO 9000 standards. Involve the heads of departments in the process. Their involvement will make the documented procedures more pragmatic and ensure their smooth implementation

7. Start working as per the laid down processes/procedures and creating the necessary records. During this period keep an open mind and revise/refine the processes/procedures.
8. Identify and train internal auditors for doing internal audit of the system for proper implementation and effectiveness. Draw out a plan for internal audits as required vide Para 4.17 of ISO 9001.
9. Carry out internal audits and initiate corrective action on the non conformities. Re-audit the corrective action for adequacy and effectiveness.
10. Approach the certifying body and start the actions needed for certification.

Conclusion :

In this article, we have briefly examined the concept of quality in a general way, discussed the ISO definition of quality and seen the various approaches to quality maintenance. The best approach to quality assurance and improvement is to have a process orientation and to set up appropriate processes and control them to produce the desired outcome. ISO 9000 Series of standards provide a model for the quality assurance systems. These are generic standards and are capable of application to education as well. The Standard provides a comprehensive framework and addresses all the various aspects of the management of quality. The ten-step plan of action is to facilitate the journey towards setting up the system and its certification. ★