9. TQM - A NEED IN ENGINEERING EDUCATION

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Abstract

Total Quality Management (TQM) is a philosophy and system for continuously improving the services and/or products offered to customers. The advantages of TQM have been valued by many companies around the world. Many organizations have achieved excellence and competitive lead by putting into practice TQM policy. Most of the principles of TQM can advantageously be employed in the area of education and training. This paper highlights the need of TQM in engineering educational institutions and explains how they can improve the quality of their services by implementing principles of TQM.

I. INTRODUCTION

Globalization and rapid technological evolutions give rise to new challenges in engineering education which is gradually changing the definition of term engineering. It is now more likely associated with the terms Strong Analytical skills, creativity, communication, business management, leadership , lifelong learning, high ethical standards etc. So it is necessary that these qualities are inculcated in the students from the present level itself. But to achieve those target, Engineering Education institutions have to focus on the quality.

The basic principles of TQM is to satisfy the customer, satisfy the supplier, and continuously improve the business processes [1]. TQM engages all divisions, departments and levels of the organization. TQM implies an open management style [3], stress on two-way communication, decentralization of responsibilities and establishment of problem solving team. It aims to win and sustain competitive advantage. Thus in educational and training sector implementation of TQM is gaining importance [6, 7].

This paper outlines the need for implementing TQM principles in Engineering Education. It gives brief introduction of TQM. Section II, highlights on engineering education system components. TQM in Engineering Education is explained in section III along with the case study of our organization. The paper ends with concluding remarks.

II. QUALITY IN ENGINEERING EDUCATION

The quality of basic engineering education system as shown in **Figure 1** is based on the components [6, 7] which are designed according to the basic requirements of any **Engineering College.**

1. Organization:

a. Infrastructure (Well equipped modern teaching aids, well equipped digital libraries and laboratories, computer and internet facilities, hostel facilities for students and staff, sports and game facilities, facilities for canteen and banking).

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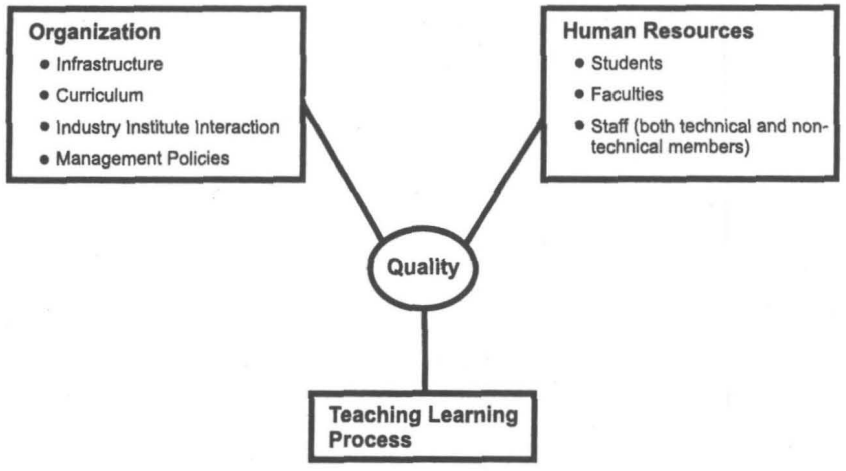


Figure 1.Components affecting quality in engineering education

b. Curriculum: Flexible dynamic curriculum, relevance of courses, joint curriculum building with industry, emphasis on training and practical, industry visits, and emphasis on lifelong learning, soft skill development and implementation of credit system.

c. Industry-institute Interaction: Coordination with industry, guest lectures, industrial training for both faculties and students, R and D with industries, seminars and conferences.

d. Management policies: Rules and regulations and budget(Operational, maintenance and development)

2. **Human Resources**: This includes Faculties (Qualified and experienced faculty, salary issues, teacher-students ratio, continuation up gradation of knowledge and skills, motivation for higher studies, exposure to industries, curriculum based training, research and consultancy), students and staff (both technical and non-technical) members.

3. **Teaching Learning process**: This includes interaction and communication between students and respective faculties, bringing out innovative, creative ideas / solutions from students and also motivating them to achieve ultimate goals.

III. TQM in engineering Education

The use of new teaching and learning methodologies, changing patterns of education delivery, course content, the concept of quality has become an essential component of the educational process for its success [6, 7]. To achieve the desired quality, TQM is an appropriate tool in education domain. It must be clearly understood, adopted and implemented as soon as possible.

Considering components mentioned in section II that affects quality in engineering education, an action plan can be prepared by addressing some quality issues for improvement of the system [6].

CASE STUDY – MMCOE

Quality issues of Engineering Education	Application of TQM/Bench Marking Principles
Creating relevance of curriculum	• Identify hard and soft skill requirements for employment. • Develop standards for each of the objectives for all the theory and practical subjects • Implementation of credit system can be made for allowing self pacing. • Credit transfer may also be allowed by having MOUs with different universities and institutions.
Management responsiveness	• Norms and standards have been fixed by AICTE for creation of infrastructure and appointment of faculty with prescribed qualifications. • NBA of AICTE is also accrediting to bring the institutes to a minimum level of acceptance. The management should follow the proper norms laid down by AICTE and create internal motivation within the institutions. • The management must have exposure and ideas like composite institutions, diversification of courses, the return on investment on quality both short -term and long term for creating a progressive outlook. • Opportunities and threats for the institution have to be realized. • Falling admission in institutions should be taken as a signal requiring qualitative improvement. • Motivating the faculty members for their self development such as selecting research area and doing continuous paper/ poster presentations (National/International) • Recruitment of good faculty and their development, appraisal and reward for retention is a challenge to all Technical Institutions.
Improving institutional academic climate	• Good Teaching-learning practices. • Transparent teacher evaluation and reward system. • Encouragement for innovations and development work. • Sponsor research work. • Conducting educational programs for both faculty members and students. • Computation facilities, laboratory and workshop facilities, library facilities need to be extended beyond the academic routine hours.

Effective curriculum implementation strategies	• Institutions need to design and develop curriculum implementation strategies such that responsibility and initiative in learning which is gradually shifted to students with teachers playing the role of managing effective and efficient learning and creating opportunities for self learning and self pacing in learning. • Faculty development programme be geared towards improvement of professional skills, viz. effective teaching-learning methods and innovations and improvement of knowledge through subject related higher studies. • For bench marking best practices, teachers need to examine how curriculum is implemented in other professions.
Attitudinal change for achieving excellence	• The present curriculum document states about knowledge and skill component, it is mostly deprived about attitudinal component except that it is inherently embedded in the system. • Both teachers and students community needs to realize the need for positive thinking and positive attitude. • Group work, involvement in planning and decision making, appreciation for good work, transparency in the system, creating conducive environment for everyone to contribute and grow. These are some of the important factors that would lead to attitudinal development. • The management and teachers need to play role models for the students to get inspired.
Linkage with industry and other institutions	• The responsibility of student's placement in industry has to be jointly taken up by the Head of the institute, training and placement officer, the heads of departments and the students. • For an established institution, the old students, well placed in industry, must be located and their involvement be planned. • Networking with organizations and institutions can be done for mutual benefits. • Investment on efforts made in placement of students will pay high dividends to the institutions in the long run.
Self learning & self paced learning	• By proper design of the teaching learning system, the students must be motivated to learn by putting their own efforts. • Exploratory type teaching learning built around open-ended problem solving activities need to be practiced. • The relevance of study of the subjects and their components has to be explained by teacher and by inviting experts from industry.

Effective evaluation system	• Student evaluation system must be valid, reliable, and should be objectively designed. • Emphasis should be on assessing the higher order cognitive skills like ability to think and apply, ability to analyse and synthesize, and of solving problems. • Multiple evaluation tools like objective and short-answer type tests, quiz, seminars, group discussion, project report preparation and presentation, etc. may be included in student evaluation. • At the university or board of examination level, there is need for developing model question papers, question banks, and table of specifications for setting question papers in various subjects. • On the basis of this analytical table, action plan can be prepared for each of the activities at management level, teacher's level and at the level of students. • A monitoring mechanism must be included to evaluate progress and providing feedback.

Considering the Quality issues of Engineering Education we have summarized some application of TQM/Bench Marking Principles which are implemented at Marathwada Mitra Mandal's College of Engineering, Pune.

Creating relevance of curriculum

Before starting of each semester the faculty members are asked to give their choice of subjects they are interested to teach depending on their specialization and experience in the respective subjects. The respective subject teachers have freedom to set their own standards for the objective of their subjects. They prepare the lesson plans and can use the various teaching methodology to make the subject interesting and knowledgeable.

Management responsiveness

Management do take care of the AICTE norms and regulations. Faculty members are promoted and sponsored for their post graduation and then to go for Ph.D. Non teaching staff are also promoted and sponsored for Graduation course. We have collected the data for PG Qualified staff from all the departments (Computer, IT, Mechanical, E& TC) of the college and the result are depicted as shown in the **fig I** graph given below.

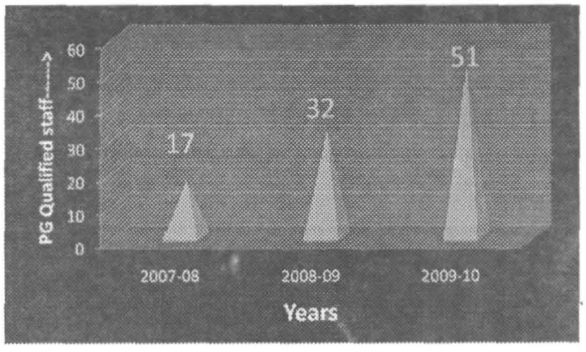


Fig 1: PG qualified in the respective years

Fig. 1. shows the gradual increment of the faculty members getting their Post Graduations.

Sponsorship is given for Paper Presentations (National/International), workshops/seminars/conferences. Financial assistance is provided to students/staff availing admissions in Ph.D in IIT. College is

encouraging faculty members to actually go and represent MMCOE at conferences abroad. College has asked management for sponsoring five faculty members per year for this. The staff members are awarded for their best performances by giving increments in their salaries. At same time staff members and students are appreciated for their achievements by giving awards.

We have collected the data for paper presentations (National/International level) and the participation of students in Conferences/ seminars by the faculty members from all the departments (Computer, IT, Mechanical, E& TC, MBA and MCA) of the college and the result are depicted as shown in the **fig II** graph (National presentation), **fig III** graph (International presentation) and fig IV (participation in Conferences/seminars) given below.

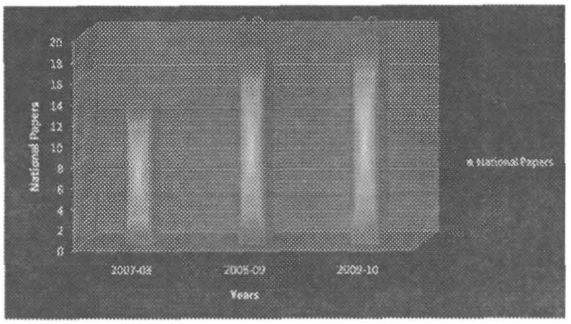


Fig 2: Paper Presented at National Level in the respective years

Fig. 2 shows the gradual increment of the faculty members for presenting papers at National Level.

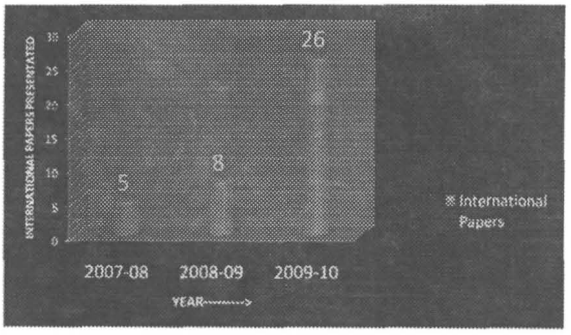


Fig 3: Paper Presented at National Level in the respective years

The graph above [Fig. 3.] shows the gradual increment of the faculty members for presenting papers at International Level.

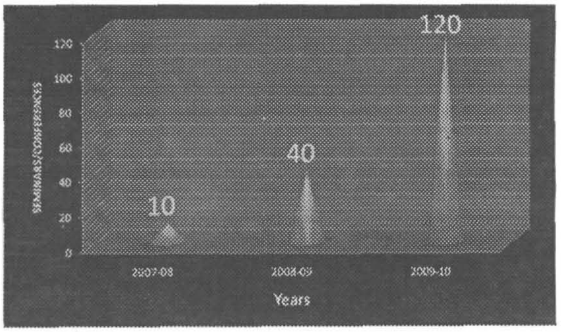
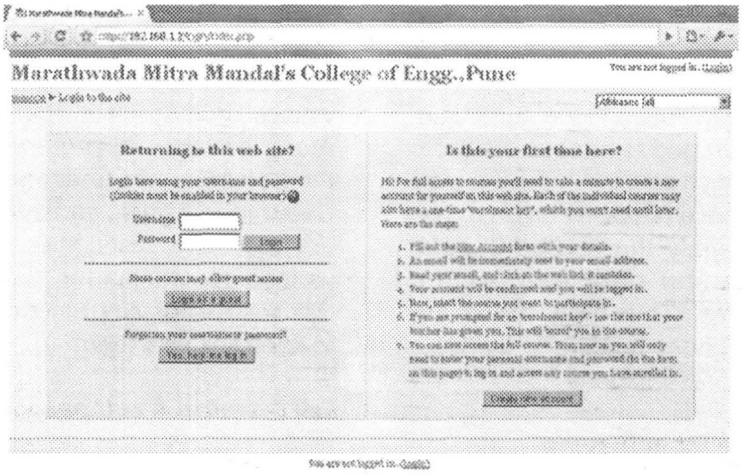


Fig 4: Participation in various seminars/ conferences in the respective years

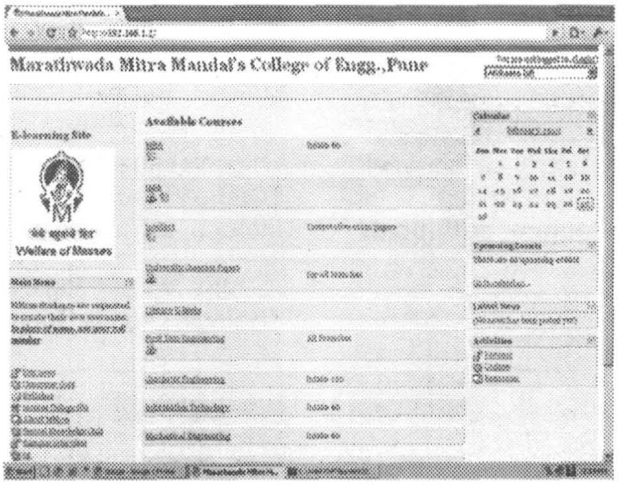
The graph above [Fig. 4] shows the gradual increment of the faculty members participation at various seminars/conferences.

Improving institutional academic climate

Teaching-learning practices are carried out by interacting with the students and motivating to bring creativity in them by giving them novel assignments to solve in groups. Transparent teacher evaluation and reward system is carried out in our organization. This is done every semester. Students give online feedback of faculty members on the Moodle Server available on intranet of the organization. Analyzing it requisite action is done for faculty members based on the feedback and other parameters (like university results, peer feedback, HOD feedback etc.). The login page of Moodle server available on the campus intranet is as shown below.



The functionalities available with Moodle server are shown below:



- An online teaching-learning program using e-learning software "Moodle"
- Moving from "teaching centered approach" to "learning centered approach"
- From e-learning portal
  - ❖ Downloading teaching material
  - ❖ Online quizzes
  - ❖ Chat with teachers
  - ❖ Messaging systems
  - ❖ Receiving assignments

Encouragement for innovations and development work is always there. Educational programs are conducted for faculty members and students. Library facilities are given apart from the routine hours. This way we create an improved academic climate in our institution.

Effective curriculum implementation strategies

Self learning is motivated in students. Apart from their curriculum some theory assignments (eg few topics related to research) are given which they have to search through the digital

library facility available in the organization. Also some small/ mini projects are assigned for implementing it in the laboratories. For the seminars which are included in the curriculum students are encouraged to choose the topic from the latest research paper (eg. IEEE paper) as their main reference paper. Then based on it they have to identify the related papers/ material/books/online data etc. for the remaining references. Thus the students are evaluated on their understanding of the topic and delivery of the presentations

Attitudinal change for achieving excellence

The management and teachers play role models for the students to get inspired. Faculty development programme is conducted towards improvement of professional skills, by encouraging faculties to work on some industry related assignments/ projects to acquire practical knowledge by visiting once in a week and get acquainted with that atmosphere. Thus to know how the curriculum defined is implemented in other professions.

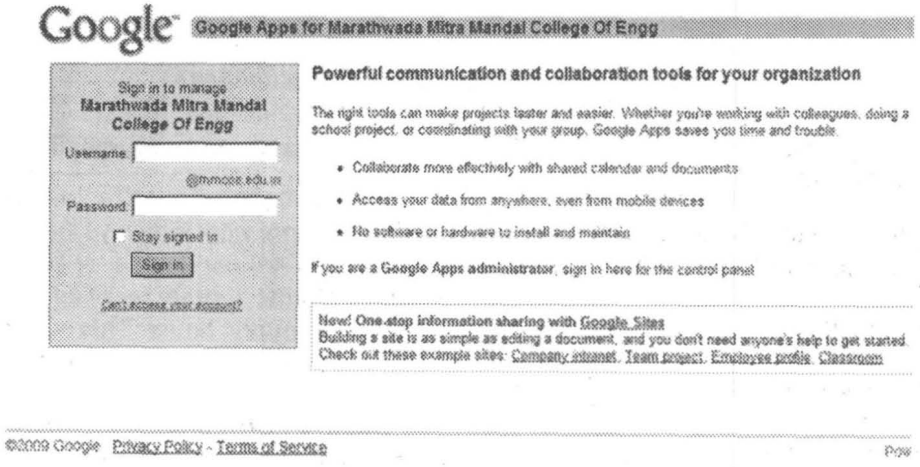
Linkage with industry and other institutions

To get familiar with the companies working environment, various guest lectures are arranged and we try to call eminent speakers who can guide them in upcoming technologies. Along with the training and placement officer the staff members and respective Head of the Departments guide students for preparing the entrances and tests/ interviews conducted by various companies for their placements. A database of outgoing student will be maintained to keep link with them.

Self learning & self paced learning

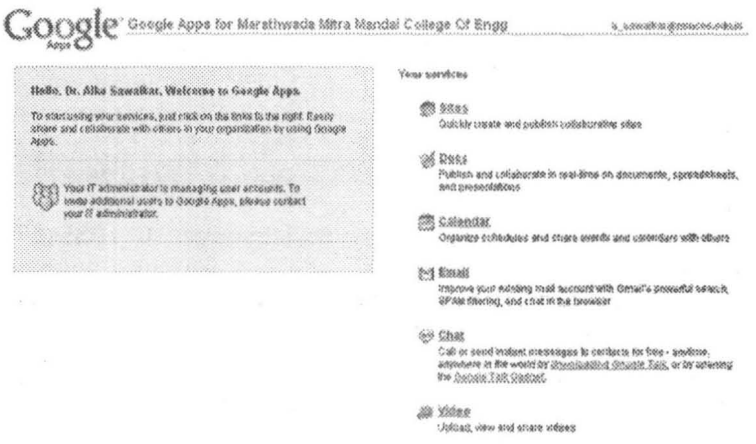
The students are motivated to learn by putting their own efforts. The organization has created its own account in Google Apps which can be made available through Internet. Through this the facility is provided by creating Individual account for each student. Using Google Apps the students can receive Lecture notes, Assignments, Question banks etc. Students can also communicate with their Class Teacher/Teacher Guardian and Classmates through it. The URL of the Google Apps is

http://www.google.com/a/mmcoe.edu.in . The login page of Google apps is shown below:

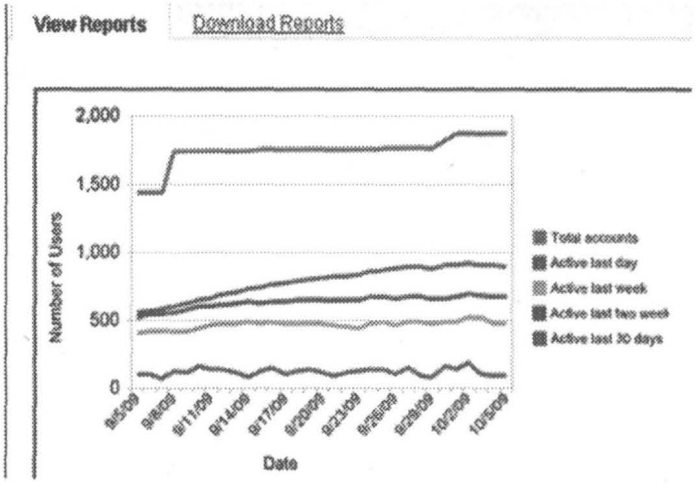


LOGIN PAGE

Functionalities provided by Google Apps is shown below:



Recent Usage reports of Google Apps is shown below:



The relevance of study of the subjects and their components are explained by subject teacher and by inviting experts from industry. Visits to various industries are often planned. We have Teacher-Guardian scheme for guidance and counselling services provided to students. We have class-room interactions and also emphasis on practical work, group projects and assignment, library study, feedback, etc.

Effective evaluation system

Internal evaluation of students performance is done by conducting Unit test weekly/monthly which includes objective type and short-answer type tests. Quiz competitions and debate competitions are organized. Seminars, group discussion, project report preparation and presentation, etc. are included in student evaluation scheme. A monitoring mechanism

is prepared to evaluate progress and thus providing feedback. Monthly parent letters are sent to the guardian's place which includes student's progressive report along with their monthly attendance. These reports are managed by respective class teachers.

CONCLUSION

Quality improvement initiatives are a must in Engineering Education system as studied in our own institution. As Engineering solutions are not going to play just plain technical solutions but they can be applied for social solutions also. Application of principles of TQM, in engineering education must be made to achieve excellence. To bring the change, mechanisms beyond existing processes will need to be developed. TQM in engineering education is excellent strategy that addresses leadership, tools and infrastructure issues. Ultimately applying TQM will lead to quality technical education.

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