

SOME PERSPECTIVES ON TOTAL QUALITY MANAGEMENT (TQM) IN TECHNICAL INSTITUTES

S G Deshmukh*

Abstract

The concepts of Total Quality Management (TQM) have become relevant for technical institutes driven by the competitive pressures and needs and aspirations of various stakeholders. A lot of emphasis is being put on the quality and standard of education provided by these institutions. Growth and survival of these institutes totally depends upon the work culture, incorporation of voice of customers and error free processes which drive these institutes. It is being increasingly recognized that high quality of products and services are associated with customer satisfaction and they are the key points for survival for any technical institute. Various concepts of Total Quality Management (TQM) are relevant in this context. To aid the successful implementation of TQM some directions are identified in this paper.

Key words: *Total Quality Management (TQM), Six-sigma, Quality Function Deployment*

1. Introduction

In keeping with the newer demands that have been placed on the educational system by the various stakeholders, the technical educational system in particular in India has been pressurized to shift its focus from one in quantitative expansion to one with emphasis on quality. The competitive pressures such as liberalization of service sector coupled with WTO are to be noted with great concern. The technical education system has, thus, begun to realize the significance of total quality management (TQM) as a response to various pressures. Lot of literature has appeared on use of TQM

in such institutes. TQM is concerned with promoting organizational effectiveness through the excellence, reliability and quality of an organization's goods and services. It is associated with every aspect of an organization's activities requiring the total commitment of every member. Its objectives are to create a quality culture and to develop the principles of error-free work. The assessment of TQM in technical education begins by attempting to share a definition, but as Taylor and Hill [1993] has argued, unlike other sectors, TQM itself is a concept, which is difficult to evaluate in higher education. According to Harris [1994], there are three generic

*Indian Institute of Technology Delhi, New Delhi 110016.

approaches to TQM - first, a customer focus approach, where the idea of service to students is fostered through staff training and development; second, a staff focus approach, that is concerned to value and enhance the contribution of all the members of staff to the effectiveness of the institute; and the third, that takes a service agreement focus and seeks to ensure conformity to specification at certain key measurable points of the educational process. The dynamic and interactive aspects of quality in

education are highlighted by Dahlgaard et al. [1995] who define total quality education as: an educational culture characterized by increased customer satisfaction through continuous improvement in which all employees and students actively participate. It is realized that few special characteristics of TQM are necessary to incorporate in technical institution. A framework depicting objectives, required characteristics of TQM and their outcomes is developed as shown in Figure 1.

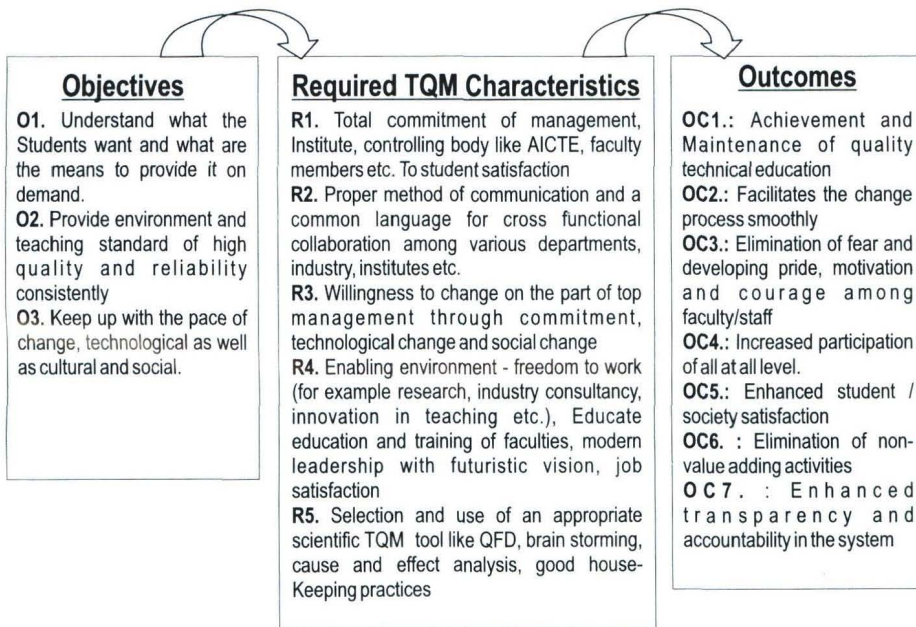


Figure1. :Objectives, Characteristics and Outcome

Quality in education can be defined as:

- Value addition in education (Feigenbaum [1951]);
- Fitness for purpose (Brennan et al. [1992];) and fitness of educational outcome and

experience for use (Juran and Gryna [1988]);

- Conformance of education output to planned goals, specifications and requirements and defect avoidance in education process

(Crosby [1979]);

Sahney et al. [2004] define quality in education from a TQM perspective and conclude: Total quality management in education is multi-faceted - it believes in the foundation of an educational institution on a systems approach, implying a management system, a technical system and a social system . . . It includes within its ambit the quality of inputs in the form of students, faculty,

support staff and infrastructure; the quality of processes in the form of the learning and teaching activity; and the quality of outputs in the form of the enlightened students that move out of the system. Thus, "quality" in education is a complex concept with varying conceptualizations and this poses problems in formulating a single, comprehensive definition. Some useful work on TQM in the context of educational institution is summarized in Table 1.

Table 1: Reported views on TQM in education

Holmes and McElwee [1995]	Presents the view that total quality management in higher education institutions, and the development of a so-called managerial ideology, has led to the inevitable adoption of an approach to HRM policy and practice which is functionalist. However, TQM in higher education may limit the productivity of individual.
Swift [1996]	Identifies problem areas for the selected engineering institution and reports the benefits of group project. It suggests the measures for improvement in quality of education with application of quality control and management.
Kwan [1996]	Attempts to trace literature that discusses the application of TQM in education and addresses the differences between industry and education. Aims to explore the relevance of employing TQM in education through criticism and benefits.
Owlia and Aspinwall [1997]	Initially a system dynamics approach is applied to strengthen the understanding on TQM in higher education. A survey and case analysis is carried out to identify the factors related to TQM in higher education and then a checklist for implementing TQM philosophy in US higher education system is developed.
Crawford and Shutler [1999]	Explains how TQM operates in the industrial context, comparison between the Crosby and Deming models, relevance of TQM philosophy in education, detailed analysis of how Crosby's model can be implemented in education, and finally a parallel analysis of how Deming's model may be implemented in education, together with a discussion of the major obstacles faced.
Sahney, et al. [2004]	An integrated approach is applied to identify the gaps

existing in quality education and customer requirements in today's modern education system.

Thakkar(2006)

Explains how QFD can be integrated into TQM

After understanding the need for TQM, it is interesting to note various perspectives that may be useful for propagating the message of TQM in education.

2. Perspective 1: Deming's 14 points

The "fourteen points" for quality in business operations as put forth by W. Edwards Deming[1993], widely regarded as the "father" of the TQM movement can also be recast for technical institutes as follows:

1. **Create and maintain a constancy of purpose toward improvement** of students and service. Aim to create the best technical quality students capable of improving all forms of processes and entering meaningful positions in society.
2. **Embrace the new philosophy.** Educational management must awaken to the challenge, must learn their responsibilities, and take on leadership for change. The change may dictate possibilities of continuous learning for teachers, active interaction with industry and government.
3. **Work to abolish grading / percentage and the harmful effects of rating people.** Focus on the learning process, not the rating process. The institutes must attempt to deemphasize the importance on marks and percentages and instead try to inculcate the habit of continuous learning amongst students.
4. **Cease dependence on testing** to achieve quality. Eliminate the need for inspections on a mass basis (standardized achievement tests) by providing learning experiences which create quality performance; learning experiences that encourage creativity and experimentation. Try to include in the curriculum open ended courses by which the spirit of innovation can be used.
5. **Work with the educational schools from which students come.** Minimize total cost of education by improving the relationship with student sources and helping to improve the quality of students coming into technical system. This may be achieved by having a strong liaison with the schools and other source institutes.
6. **Improve constantly and forever the system of student improvement and service** to improve quality and productivity in personal life and community. The framework of Plan-Do-Check-Act can be very useful in this regard.
7. **Institute continuous training on the job** for students, teachers, supporting staff and administrators; for all people connected with the technical

education. Incentives may be provided for such training. The initiatives such as QIP, TQIP by AICTE are welcome initiatives in this direction.

8. **Institute leadership.** The aim of supervision (leadership) should be to help people use technology (educational technology such as multi-media, web support etc.) and resource materials to do a better job and set the pace driving human creativity.
9. **Drive out fear**, so that everyone may work effectively for the system. Create an environment which encourages faculty and support staff to speak freely and take risks so as to improve the quality.
10. **Break down barriers between departments. People in teaching, as a cohesive team.** Develop strategies for increasing the cooperation among groups and individual people. Planning time will facilitate this dynamic.
11. **Eliminate slogans, exhortations, and targets for teachers and students asking for perfect performance and new levels of productivity.** Exhortations create adversarial relationships. The bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the control of teachers and students.
12. **Eliminate work standards (quotas) on teachers and students** (e.g., raise college results by 10%; lower dropouts by 15%). Substitute leadership,

the eternal drive for quality, and joy of learning.

13. **Remove barriers that rob the students, teachers and management** (principals/directors, superintendents and office support staff) **of their right to pride and joy of workmanship.** This means abolition of the annual or merit rating and of management by objectives. The responsibility of all educational managers must be changed from quantity to quality.
14. Put everybody in the community to work to accomplish the transformation. The transformation is everybody's job and institute a vigorous program of education and self-improvement for everyone

In this light, the "three Cs"—a focus on customers, culture, and capacity for continuous improvement—which are the signature features of total quality environments and which many successful businesses have used to rejuvenate themselves are very important. .

The Customer: Total quality really has two kinds of customers in mind—the external customers, who "consume" the product or service offered, and the internal customer, i.e., those who, in the process of creating a product or service, receive the output of another's work, with each successive person adding something of value....if everyone does his or her job in a way that eliminates problems for the next person up the line, the final customer...will be satisfied....

The Culture: A successful change

strategy involving quality management also involves a commitment to create a specific kind of organizational culture based on trust and shared decision making. The work culture envisaged is open and hierarchy-less structure which encourages free voice, a cornerstone of any academic environment.

The Capacity: Leaders in quality-oriented organizations seek ways not merely to change but to manage and instill the change process itself: in Deming's terms, they achieve "constancy of purpose"....

It must be noted that total quality is about systemic change. The "lead actor" in TQM is...the process of systemic change itself...The point is to develop the organization as an integrated, organic set of relationships, and to gain the ability to change and direct those relationships again and again in the direction of improvement—as defined by the organization's internal and external customers. These and other TQM concepts, together with their potential application in educational environments are very much relevant in our case. Matthews [1993] cited the following four critical barriers to the utilization of TQM in academia:

- ◆ The highly generic and inappropriate nature of an average institution mission;
- ◆ A lack of agreement within the academic environment as to the meaning or implications of "quality and excellence";
- ◆ The independence of key individuals within the academic environment; and
- ◆ The reluctance of college or university leaders to play an aggressive and creative role in

TQM implementation.

Appropriate care must be taken to sensitize all the stakeholders to be aware of the above pitfalls and accordingly train and educate the stakeholders so that the basic framework is properly implemented (Deshmukh, 2003).

3. Perspective 2: Quality Function Deployment

Historically, Quality Function Deployment (QFD) originated possibly as an outcome of Deming's teachings. QFD which is a customer-driven planning process, answers 'What' and 'How' questions by capturing the voice of the customer-industry and society; breaking down quality into tangible, manageable, technical and operational actions so as to ensure that the customers' needs and expectations are timely met. It is a conceptual map for inter-factional planning and communication. It helps in determining opportunities that can be developed effectively to achieve total customer satisfaction. In the continuous learning and evolving environment of technical institution it is extremely difficult to keep pace with changing curriculum requirements and students' expectations and hence knowing the opportunities lying down the line helps institution in upgrading their standards timely and effectively. QFD presents an opportunity to move away from "we know best what the customer wants" to a new culture of "let's hear the voice of the customer". In a sense it enables the organization to become very much proactive to quality problems rather than being reactive to them by waiting for customer complaints. QFD has three major objectives: to identify who

the customer is, what the customer wants and how to fulfill the customer's wants. In the today's era of globalization customers - students of these institutions are looking for the education standards and environment, which can put them at par with the emerging market trends, technological developments and competition. QFD is an essential pillar for achieving TQM. The TQM literature indicates that building the quality into the service starts with asking what does the customer need. QFD is a useful tool in answering this question. In addition, the "how's" of the QFD or the "voice of the company" are important for explaining how the organization meets or exceeds the customer needs. In addition, by recognizing the interrelationships between the engineering properties of the product and the customer requirements, appropriate actions can be taken at every stage of the product's development, so that customer needs are anticipated, prioritized and effectively incorporated into the product. In the context of technical institution where student's requirements are continuously changing with the rapid technological advancements, timely changes in curriculum, student-teacher relationship, and faculty improvement aspects, industry-institute togetherness, R&D scope etc. can be incorporated. QFD has three fundamental objectives. These are: (1) to identify the customer; (2) to identify what the customer wants; and (3) how

to fulfill customer's wants (Thakkar et al, 2005). It offers the ability to prioritize customers' own preferences and following a ranking procedure, suppliers may not necessarily have to focus on customers' top priorities if these are strong enough on other aspects which they may be weak at. One can perceive students as customer to today's educational system. In this step students' voice can be expressed in distinct actionable requirements from the hard issues of infrastructure to the softer issues of work culture, discipline and teaching standard. It requires the attention to both tangible and intangible parameters. Now all these requirements are not of same importance from students' point of view and hence customer importance rating to these detailed requirements can be given on the scale of 1 (least important) to 10 (most important). The process starts with the construction of house of quality, which requires the identification of the customer's requirements. These describe product characteristics or represent areas of concern. It is, however, easy to use questionnaires to obtain the voice of the customers, and rank the different aspects of customer needs, especially in this case and in cases when information is not personal or confidential. These needs may be pertinent to different areas like infrastructure, culture, library and research standards etc. An illustrative classification of all these requirements is given in Table 2.

Table 2: Customer - student requirements identification (Thakkar et al., 2006)

Broad classification	Codes	Detailed requirements
Infrastructural requirements (A)	A1	Institution building and premises
	A2	Availability of sufficient space for various

		laboratories and classrooms and meeting rooms
	A3	Seminar halls, syndicate rooms
	A4	Auditorium
	A5	Hostel and messing facility
	A6	Quality and standard of the equipments available in laboratories
	A7	Sports and recreation facility complex
	A8	Transport facility
	A9	Research facility (Library, Labs, paperwork related to funding)
Teaching standard (B)	B1	Educational Qualifications of teaching staff
	B2	Teaching experience of faculty
	B3	Industry experience of faculty
	B4	Research work and publications of faculty
	B5	Method and quality of teaching
Overall working culture of institute (C)	C1	Respect for each other
	C2	Attitude of teachers towards students
	C3	Attitude of students towards teachers
	C4	Attitude of top management towards staff and teachers
	C5	Number of activities arranged by faculty members for the holistic development of students
	C6	Number of initiatives taken by the students in extra curricular activities along with studies
	C7	Support of administrative staff to students and faculty members
	C8	Directions and Promptness from the Head of the institute
Opportunities provided by institute (D)	D1	Student participation in inter college an state or national level competitions
	D2	Number of students recruited by the campus interview
	D3	Number of industry tours arranged outside
Industry -institute interaction (E)	E1	Number of industry visits arranged by the institute institute
	E2	Number of industry projects under taken by

	E3	Technology transfers and know-how transferred to industry
Students' involvement in institute activity (F)	F1	Selection of student representatives and their importance and involvement in some joint ventures
Institute- Institute interaction (G)	G1	Number of combined projects handled with other institutes
	G2	Involvement of experts of other colleges in examination - evaluation and curriculum development process
Exposure to global standards (H)	H1	Interactions with well established institutes
	H2	Visits to some advanced multinational organizations
	H3	Access to internet facility
Transparency (I)	I1	Transparency in admission and evaluation process
	I2	Timely assessment and declaration of results
	I3	Fees charged to students and variations in the same
Faculty development (J)	J1	Number of training programmes conducted for the faculty development
	J2	Number of faculty members sent for higher studies
Library standards (K)	K1	Number of books available
	K2	Standard of available books
	K3	Number of National and International journals subscribed

After establishing the whats from customer's point of view, the corresponding hows (called as technical requirements) can be derived. These requirements represent how an institute will respond to customer wants and needs. The first step is to translate the customer voices into technical requirements. The technical requirements may not represent solutions. The objective is to translate each voice into one or more technical requirement. An illustrative list of technical requirements is given in Table 3.

Table 3: Technical requirements and their implications on technical institutions (Thakkar et al., 2006)

S. No.	Technical characteristics	Implications on technical institutions
1	Well defined policies and procedures	Improves overall working culture and relationships among different echelons of

		academic system
2	Clear and transparent organization structure	Develops clarity on roles and responsibilities on teachers as well as student's side
3	Delegation of authority	Makes the individual responsible and controls over functional autonomy in academic system
4	Discipline	Improves overall working culture and helps in building brand image in competitive academic environment
5	Budget priorities	Optimizes the resource constraints and helps in deriving maximum satisfaction of students
6	Emphasis on continuous improvement	Updates the standards of technical institute with rapidly changing technological environment and improves overall competitiveness among academic industry
7	Cross functional collaboration	Helps in developing competitive benchmarks and brings the synergies of learning
8	Suitability and relevance of curriculum	Brings maximum benefit to students and ultimate customer - industry in satisfying their changing requirements
9	Participation and involvement	Improves teacher-student interaction, establishes faith, trust and understanding and highlights the facts to the management for further improvements
10	Trustworthiness among all	Develops respectability and brings synergy of effort and knowledge
11	Employment opportunities for students	Satisfies the ultimate customers and improves brand image of institute in education industry
12	Feedback of Students performance	Brings timely necessary modifications to the tangible by the industry and intangible areas of curriculum, discipline, attitude building, student motivation, improvement in communication skills, etc.

After establishing the whats and the hows, construction of the relationship

matrix can be initiated. Building the relational matrix, requires the analysis of any kind of relationships existing between every what and every how. All relationships are categorized as either strong, medium, or weak. Different numbers (1, 3 and 9 for weak, medium and strong respectively) are used to signify different relationship strengths and the relational matrix is constructed. The allocation and categorization of the relationships are carried out through careful consideration. An example of a strong relationship would be between college building and budget priorities. An example of a weak relationship would be between respect for each other and budget priorities (Thakkar, 2006).

Concept of QFD implementation is continuous and evolving in nature. Each phase of QFD provides the opportunity for further improvements through new comparisons towards the achievement of ultimate goal of the system. The goal of any technical institute is to achieve certain long lasting academic standards like coherent environment of learning and teaching, imparting value

to students, fairness in examination and management policies, participation at all levels and so on. The QFD perspective shall help an institute to realize the needs of its customer. As an institute finds itself nearer to the achievement of established standards in the first phase it can develop the comparisons and benchmarks for the second phase. For example, in the first phase of QFD, we can develop the relationships between requirements and technical characteristics, in the same way second phase may comprise the comparison of technical characteristics and characteristic of academic activity and hence at this stage rating of characteristic of academic activity can be determined and so decisions related to it can be also be prioritized. Likewise the process continues and further at each stage new benchmarks can be established and opportunities for further improvement can be explored. The complete process of QFD development requires lot of brainstorming, participation of all levels and continuous modifications(Sahney et al., 2004).

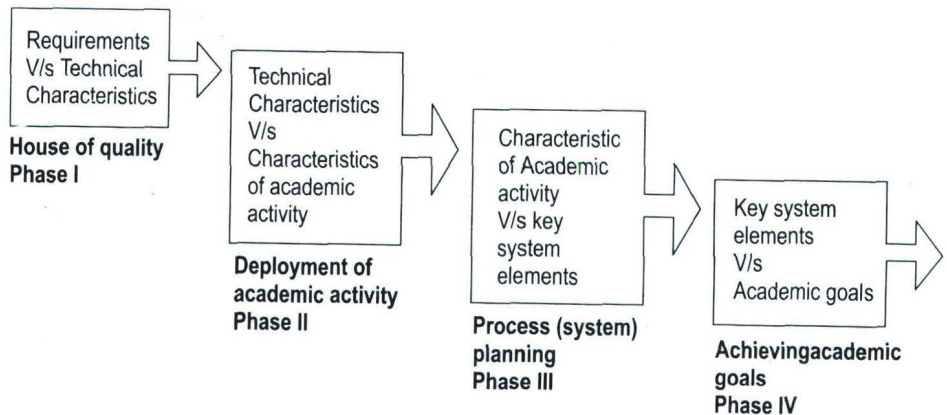


Figure 3 :Continuous process for QFD in technical institutions

Like wise depending upon the importance ranking of characteristics quality improvement steps can be initiated and a systematic review and audit system can be established for their timely implementation and long

term survival. In a more focused way implications of proposed approach for various stakeholders such as faculty, students, alumni, financial bodies, All India Council for Technical Institution (AICTE) etc. are highlighted in Table 4

Table 4: Implication of implementing QFD on various agencies

Implications	- Initially it may include some threat in the conventional mindset of academicians but in the long-run it will create and provide learning environment and opportunities for continuous improvements in teaching standards as well as at an attitudinal level. - It helps the faculty members to learn and go more nearer to the students and industry by understanding their expectations and comparing the existing standards with set benchmarks. - Learning environment helps faculty member in improving the quality of their research by cross functional efforts through better interaction with different department of same or other institute, industry, controlling bodies, students etc.
Agencies	
Agencies	
Students	- It provides the faith, satisfaction and confidence to ultimate customers that they are trained under the well defined competitive standards and completion of course will help them to grow in demanding market. - Develops better interaction among students and helps in creating self motivated learnin environment.
Alumni	- Develops faith and more funds and support can be expected from former students. - Satisfied students will do better marketing for an institution and hence the biggest problem of getting good students for self finance institution can be handled.
Financial bodies	- It will increase their trust and more funds can be made available for the sustainable development - Systematic concept improves the image of institute and reputation of their students will get a

better priority in availing financial helps for the higher qualification in domestic as well as foreign continent.

All India Council for Technical Education (AICTE)

- It will provide a concrete platform for assessing and comparing the upcoming and established institutions
- Financial help and support can be provided on the justifiable
- assessment and degree of making continuous improvements in various aspects like infrastructure, teaching standards, faculty development, motivation for research etc.
- The various levels of maturity stages for a technical institution can be defined for ranking and setting the guidelines for continuous improvement within which each institute gets the flexibility to set, define and maneuver the procedures for achieving prescribed standards and benchmarks by AICTE.

Especially the developed framework will help more to the upcoming technical institutions by providing systematic and logical benchmarking directions for continuous improvement. It is expected that the QFD perspective will provide following benefits to technical institutions: It will sensitize the institutions about student requirements, expected services and quality of education in the present ever-changing technological environment and will also help the institutions in understanding the technical characteristics of the engineering education and their relationships with the students' requirements.

4. Perspective 3: Six Sigma Approach

Six sigma is a disciplined, customer-focused process designed to help organizations move towards the creation of near-perfect products and services. The term "sigma" is a

statistical term that measures how far a given process deviates from perfection. The central idea behind six sigma is that, if one can measure how many "defects" are there in a process, one can systematically figure out how to eliminate them and get as close to "zero defects" as possible. A defect in the context of Six Sigma is defined as "anything that does not meet the customer requirements". For example, in academics the following issues could result in defects which ultimately cause customer(student) dissatisfaction:

- the relevance and nature of information provided by the teacher to the students;
- unavailability of teacher when students want to clarify some doubts;
- delays in evaluation and preparation of results;
- unbalanced structure of

examination paper means not providing the sufficient scope to various levels of students to show their abilities;

- the behavior of the teacher within and outside the classroom;
- teacher's inability to understand student psychology and learning curve;
- Inefficiency of teacher in motivating the students towards learning etc.

Six Sigma is a rigorous and disciplined methodology that uses data and statistical analysis to measure and improve a company's operational performance by identifying and eliminating "defects" in various processes. Six Sigma has been perceived as a unified approach to process excellence. It has transformed some of the most successful companies in the world, such as Motorola and GE. It is activated as an approach of aiming at a target by changing the culture of a company, involving everyone in the company. The concept of Six Sigma is to identify the problem in a process, charter a project to specifically address the process, evaluate the process and work through the project in order to improve the process in totality. In education, Six Sigma pertains to improving the quality of subject matter taught, the character generated of the students, and the quality of study. The culture of Six Sigma suggests a work environment and quality of work life where everyone in the organization desires to achieve the Six Sigma target, to increase customer satisfaction, to increase efficiency, to lower costs and to improve visibility of the institute. This culture

provides an important and continuing focus to management. The Six Sigma quality concept penetrates — applying to all processes within a company. The implementation in the educational arena requires the teachers to be considered 'a vital service provider'. The customers tend to be the parents who pay the fees and want quality in return of the good result of their wards.

The implementation or application of Six Sigma starts with the recognition of a problem, and the defining of a project to solve that problem. The project is undertaken by a team using DMAIC, which stands for Define, Measure, Analyze, Improve and Control. These are defined further as:

DEFINE: This phase involves the definition of the project/assignment, using process map, application area, desired improvement, likely benefits, etc. The importance lies in having the chance of a high successful delivery of better quality and saving costs in totality. In the context of academic strata, the failures include identifying and defining the problem. Projects may include real life problems such as *distractions in the classroom*, for example. Other example, could be low attendance in a class.

MEASURE: This phase involves the analysis of the process to determine its present state and the desired future state, as obtained. Data collection is the main emphasis of this phase.

ANALYSE: This phase involves the data analysis for identification of parts of process which affect the quality of the problem. This may involve drawing of flow charts/cause effect diagrams and other tools to analyze the typical problems.

IMPROVE: This phase adds to the process to find a permanent solution to the problem. This may involve better forecasting, better scheduling, better procedures or equipment, specifying teaching techniques, work environment for the teachers, and school campus quality life.

CONTROL: This phase involves the process of closing the problem by putting in the right procedures and management statistics.

5. Concluding remarks

The usefulness of TQM concept for technical education is elaborated in this paper. Various perspectives borrowed from the domain of TQM are highlighted. The Deming's philosophy helps in sensitizing the educational institutes. The quantitative framework of QFD identifies some of the fundamental requirements and characteristics of the technical institutions. It is expected that the obtained relationships and prioritized characteristics through QFD will develop useful insights into the overall development and streamline the processes. QFD integrates the essential and crucial elements of a given system to develop positive synergy through better utilization of skills. The six-sigma approach helps in evolving error-free processes within the gamut of various activities of these institutes. It will also help in giving a quantitative outlook towards various processes in DMAIC format. It must be noted that in the emerging competitive scenario where the performance of an institute is closely watched by a variety of stakeholders, it is imperative that technical institutes start implementing the concepts of TQM.

References

1. Brennan, J., Goedegebuure, L.C.G., Shah, T., Westerheijden, D.F. and Westhop, P.M. (1992) "Towards a Methodology for Comparative Qualitative Assessment in European Higher Education" CNAA, CHEPS, HIS, London.
2. Crawford, L.D. and Shutler, P. (1999) "Total quality management in education: problems and issues for the classroom teacher", *The International Journal of Educational Management*, Vol 13 No 2, pp. 67-72.
3. Crosby, P.B. (1979) "Quality is Free" McGraw-Hill, New York, NY.
4. Dahlgaard, J.J., Kristensen, K. and Kanji, G.K. (1995) "TQM and education", *Total Quality Management*, Vol 6 No 5/6.
5. Deming W E, 1993, *The New Economics for Industry, Government, and Education*, MIT/CAES
6. Deshmukh S G, 2003-2004, *Vision for engineering education in India: Some considerations*, *Journal of Engineering Education*, Vol 27(2/3), pp 71-83
7. Feigenbaum, A.V. (1951) "Quality Control: Principles, Practice and Administration" McGraw-Hill, New York, NY.
8. Harris, R.W. (1994) "Alien or Ally?" *TQM, Academic Quality and the New Public*

- Management, Quality Assurance in Education, Vol 2 No 3, pp. 33-9.
9. Holmes, G. and McElwee, G. (1995) "Total quality management in higher education: how to approach human resource management" *The TQM Magazine*, Vol 7 No 6, pp. 5-10.
10. Juran, J.M. and Gryna, F.M. Jr (Eds) (1988) "Juran's Quality Control Handbook" McGraw-Hill, New York, NY.
11. Kwan, P.K. (1996) "Application of total quality management in education: retrospect and prospect" *International Journal of Educational Management*, Vol 10 No 5, pp. 25-35.
12. Matthews, W.E. (1993) "Total quality management in academia - the missing element in higher education" *Journal of Quality and Participation*, January/February, pp. 102-8.
13. Owlia, M.S. and Aspinwall, E.M. (1997) "TQM in higher education - a review" *International Journal of Quality & Reliability Management*, Vol 14 No 5, pp. 527-543.
14. Sahney, S. and Banwet, D.K. and Karunes, S. (2004) "A SERVQUAL and QFD approach to total quality education A student perspective" *International Journal of Productivity and Performance Management*, Vol 53 No 2, pp. 143-166.
15. Sahney, S., Banwet, D.K. and Karunes, S. (2002) "Quality function deployment and interpretive structural modeling for development of a total quality education framework for a developing country" *Proceedings of the 7th International Conference on ISO 9000 and TQM, (VII-ICIT)*, Centre for Management Quality Research (CMQR), Royal Melbourne Institute of Technology, Australia.
16. Swift, J.A. (1996) "Using TQM to Identify Education Improvement Opportunities in the College of Engineering at the University of Miami" *Computers in& Engng* Vol 31 No 1, pp. 13 - 16.
17. Taylor, A.W. and Hill, F.M. (1993) "Issues for implementing TQM in further and higher education: the moderating influence of contextual variables" *Quality Assurance in Education*, Vol 1, No 2, pp. 12
18. Thakkar J, Deshmukh S G and Shastree A., 2006, A Total Quality Management (TQM) in self financed technical institution: A Quality Function Deployment (QFD) and force field analysis approach, *Quality Assurance in Education*, (Forthcoming)

