

Full Length Research Paper

Evaluation of quality in an educational institute: a quality function deployment approach

Vikram Singh^{1*}, Sandeep Grover² and Ashok Kumar³

^{1,2}Department of Mechanical Engineering, YMCA Institute of Engineering, Faridabad (Haryana), India.

³YMCA Institute of Engineering, Faridabad (Haryana), India.

Accepted 21 November, 2019

Quality Function Deployment (QFD) is one of the Total Quality Management (TQM) techniques which can be applied for process and design improvement. This paper develops a framework for quality in an educational institute on the basis of literature review. A relationship matrix is developed between five identified groups of 'Dimensions of Quality' and twelve sets of 'Enablers' in an educational institute. It further outlines a QFD model based on interrelationship and intra relationship among dimensions of Quality, Enablers and customers. The indices developed based on the QFD matrix are utilized for quality planning and monitoring. The procedure is equally important for different types of technical institutes for self analysis, enhancing effectiveness and generating Competitiveness

Key words: Education institute, QFD, relationship matrix.

INTRODUCTION

Total Quality Management has been used successfully in a variety of organization viz., health care organizations, government agencies, educational institutes, banks, library, transportation facility etc. The continuous presence of these agencies makes the survival of these agencies extremely difficult specifically educational institutions. Growth of the educational institutes depends on the environment, working style, and ultimately the satisfaction of the customers. To serve the interest of the stakeholders, institutes realize the importance of TQM principles. The philosophy of these TQM principles underlines the necessity of satisfaction and commitment at all levels. Top management commitment helps in the development of an institute wide culture where the impact can be realized. The present scenario demands understanding and fulfilling the needs of stakeholders.

Quality Function Deployment (QFD), developed by Akao (1990), is one of effective tools which understand customer perspective and transform it to the capabilities of the organization. It can be defined as a system for designing a product or service based on customer demands and involving all members of the organization. It helps to determine opportunities that can be developed

effectively to achieve total customer satisfaction. QFD can be considered as prerequisite of TQM. In this current era of globalization customers look for the standards and environment which will satisfy their needs. QFD is an essential pillar for achieving TQM. Quality movement in almost every country usually starts with quality improvement projects at manufacturing companies. Total quality management (TQM), as this paradigm is now called, spreads later to service companies such as banks and insurance companies, and eventually to nonprofit organizations such as health care, government, and education institutions. TQM models, based on the teachings of quality gurus, generally involve a number of "principles" or "essential elements" such as top management's leadership, teamwork, customer focus, employee involvement, training, continuous improvement tools and several other elements, which are all required for successful TQM implementation. In fact, many prominent quality awards, such as Deming Award in Japan, Malcolm Baldrige in the USA and the European Quality Award, have adopted these essential elements of TQM as their award criteria (Mete B. Sirvanci-2004).

"Quality in higher education is a complex concept that has eluded clear definition" (Marshall, 1998). There are a variety of stakeholders in higher education including students, employers, teaching and non-teaching staff, government and its funding agencies, accreditors, valida-

*Corresponding author. Email: vikramsingh_ymca@hotmail.com.

tors, auditors, and assessors (including professional bodies) (Harvey and Burrows, 1992). Each of these stakeholders has a different view on quality, influenced by his or her own interest in higher education. For example,

To the committed scholar, the quality of higher education is its ability to produce a steady flow of people with high intelligence and commitment to learning that will continue the process of transmission and advancement of knowledge.

To the government, a high quality system is one that produces trained scientists, engineers, and architects, doctors and so on in numbers judged to be required by society.

“To an industrialist, a high quality educational institution may be one that turns out graduates with wide-ranging, flexible minds, readily able to acquire skills, and adapt to new methods and needs” (Reynolds, 1990).

Each of these views represents a valid expectation of higher education and about its quality. The measurements thus required and the standards to be applied will surely be different for each of these notions of quality.

Quality in educational institutes

While higher education institutions are the home for learning and creating knowledge through their research function, it is ironic that they have been lagging behind other organizations in embracing and implementing TQM. This inertia in the adoption of TQM seems to be due to certain structural and traditional characteristics of higher education institutions. There are also some special challenges that are not encountered in other organizations. Quality in higher education is treated from different perspectives in other articles in the literature. For example, measurement and evaluation of quality in higher education are studied in by different authors (Grant, 2002; Tranter, 2001; Bennett, 2001). On the other hand, Owlia and Aspinwall (1996) discuss the findings of a survey conducted to examine the different views and investigated the impact on the satisfaction of customer and then the applicability of industrial quality management principles to higher education.

Attributes unique for educational institutes

In a comprehensive examination of the services of educational institutes, (Zeithaml et al., 1985) identified four primary characteristics of services:

1. Intangibility
2. Inseparability of production and consumption
3. Heterogeneity.
4. Perishability.

All of these can be found in education. Intangibility is a major distinguishing feature of services, but applies parti-

cularly to education where the specific nature of the service offering is difficult to define. One of the effects of intangibility is that services cannot be stored (Sasser, 1976). For education institutions this can pose problems through either overcrowding or a lack of capacity. Intangibility also creates difficulties for the protection of services through patents (Judd, 1968). Intangibility also makes it difficult to easily display or communicate services to the customer (Rathmell, 1966)

The difficulty in separating production from consumption in services poses additional problems. One of the principal outcomes of this aspect of services is the need to involve the customer in the production of the service (Booms, 1981). This is particularly the case with education, where student participation in their learning process is a critical factor in determining success (Shuell and Lee, 1976). Another aspect of this same problem is the likelihood that more than one consumer will be involved together in the production of the same service (George, 1977; Gronroos, 1978). Education has long been undertaken within a group and has been viewed as an important cultural transmission process (Singleton, 1974).

The heterogeneity of services poses significant problems in the area of quality control and standardization finally, the perishability of services means that they cannot be placed into inventory and thereby creating the problem of under or oversupply.

Problems faced in implementing TQM in education

The definition of customers and the ability of the customers to influence contents of the courses is one of the major concerns, which affect the TQM implementation. Students as customers after all lack the wisdom and knowledge to influence the contents of the courses.

Clarity of purpose of educational institutions has never been so far an issue that has to be addressed (Kells, 1995).

The adoption of the industry sense of TQM, i.e. production processes- centred, causes a lot of problems in the educational setting.

The somewhat complex delegation and decision-making process in an educational setting creates another problem.

Definition of customer

The question of “customer” for higher education poses a very sticky problem. Institutions or colleges are not unanimous on a specific definition of customer. There appears to be something inherently ominous about defining a higher education customer as the student. The definition that “customer is always right” is not considered as appropriate by the faculty; the reason being that ‘satisfaction of wants’ does not necessarily lead to high quality education. This belief is based on the assumption that a happy student is one who merely passes classes and

graduates, so students are only concerned with short-term satisfaction (making the grade), as opposed to actually learning and growing (long-term gain). Faculty and administrators tend to hold the belief that they know what the students need, whereas the students may not necessarily be privy to this information at the early stages of their educational development. The students alone as the customer are reflected in the definitions used by the leaders of the TQM movement in higher education.

Samford University defines its customer as the student customer but states "many contemporary academics feel the term 'customer' is too crass a commercial term, denoting a cash exchange" (Harris and Baggett, 1992).

Harvard University states, "The customer is defined as anyone to whom we provide information or service" (Hubbard, 1994a).

Oregon State University, perhaps the most highly touted TQM follower in higher education, considers its customer in this light: "Our students are our purpose for existence" (Coate, 1990a).

Northwest Missouri State bases its customer focus on the following precept: "in the classroom, the students along with the instructor are 'suppliers' who produce a 'product' (knowledge) that future 'customers' (employers or graduate schools) will evaluate" (Hubbard, 1994b).

Fox Valley Technical College believes the customer to be "students who use our services and employers who are ultimate consumers of our graduates" (Spanbauer, 1987).

Despite what term one chooses to use, the student is the primary component of the customers served by higher education. Still, there are additional entities that must receive recognition and respect in the provider/consumer chain.

In summary, it appears that all of the above-mentioned colleges and universities believe that their customer consists of either the student or employer or both.

Overview of QFD

QFD is one of the successful approaches for attaining off line quality. It is an important communication vehicle. It is similar to Juran's quality planning concepts, which begins with the 'identification of customers' and ends with the 'transfer to operations'. The Japanese use what they call Quality Function Deployment (QFD) to plan the quality related aspects of products (Akao, 1983). It is literal translation of Japanese words *hinshitsu kino tenkai*. Developed in 1966, the concept was first brought to the attention of U.S. companies by Yoji Akao in 1983 (Akao, 1983). Although companies compete on quick response to customers need, timeliness must be accompanied with quality, flexibility and cost efficiency (Zairi and Youssef, 1995). The QFD process brings together the essential elements and crucial characteristics of the various phases in the lifecycle of a product, from its conception through design, development, manufacture, distribution

and use. It focuses and coordinates skills within an organization, and encourages teamwork between marketing people, design engineers and manufacturing staff (Logothetis, 1997).

QFD as an organized system was first introduced at Kobe Shipyards of Mitsubishi Heavy Industries Ltd. in 1972. The purpose of QFD was to enable producers to excite the customers with their products to develop large market shares and generate higher profits. QFD leads to better product design, lower product costs and shorter development time (Vonderembse et al., 1997).

QFD and higher education

QFD is a planning technique which originated in Japan in 1972 and has proven its ability for quality improvement. Applying QFD, as a TQM technique, is one of the logical consequences of a customer-oriented approach to quality. In this technique, the customer's needs and expectation are identified and then translated into technical specifications which determine the design quality of the product or service. A multi-dimensional matrix, sometimes called the 'house of quality' because of its shape, is used as a basis for demonstrating the planning procedure. Identifying customer requirements, evaluating priorities of the requirements, identifying technical characteristics are the main steps in a QFD analysis.

The widespread success reports of application of QFD in industry have generated interest for the academics and researchers to apply the QFD in the service sector like healthcare, banking. Higher education is one of the recent areas in which the potential has been challenged. Literature reports various views on application and interpretation of QFD approach in the education. Some of the interesting experiences found in literature are listed in Table 1.

Quality dimensions for education

The quality dimensions specific for education was found from literature review and a new frame work with corresponding characteristics is developed. The 70 attributes identified are grouped into five dimensions: organization and governance, financial resources, physical resources, teaching-learning process, supplementary process. A QFD matrix was constructed from the dimension of quality found through literature review along with their characteristics. In QFD approach the process start with the construction of house of quality which requires the identification of customer's requirements.

Application of QFD to an educational institute

The selection of requirements was crucial since it would determine the 'subject' of improvement. Literature review shows that customer of an educational institute can be either or all of these student, staff, employer. Therefore

Table 1. Literature review of application of QFD.

Author	Views
Jaraiedi and Ritz(1994)	Applied QFD to two processes, 'advising' and 'teaching', in an engineering department. Here, they considered students as the main customers. Student's requirements were studied and compared with some 'design' requirements developed for each process. On the basis of calculated importance ratings and target values for the design requirements, conclusions were made on the ways that quality could be improved.
Pitman et al. (1995)	Applied QFD in evaluating a MBA programme at university. The requirements of three groups, i.e. students, employers and academic staff, were taken into account. Their results, though not detailed, revealed the strengths of their present programme as well as areas that required more attention.
Ermer (1995)	In his study of mechanical engineering department, requirements of customers-students, academic staff and industry-were analyzed separately. In the case of students, their requirements regarding curriculum and teaching processes were compared with measurable specifications of the programme. The QFD matrix for staff, however, was quite different, since their own requirements were correlated with the responsibilities of the department management.
Lam and Zhao(1998)	Paper addresses the issue of improving quality of teaching with the use of QFD and AHP.
Owlia and Apinwall (1998)	Applied QFD for the improvement of quality in an engineering department.
Fiorenzo Franceschini and Marco Terzago(1998)	Applied QFD to industrial training courses and identified the two major differences between the application of QFD for product development and for education.
Bouchereau and Rowlands (2000)	Article explores the integrated use of techniques like fuzzy logic, artificial neural networks, and the Taguchi method with QFD to resolve some of its drawbacks, and proposes a synergy between QFD and these three techniques.
Hwang and Teo (2001)	In this paper they demonstrated how an institution in higher education can apply the three-phased, service-based quality function deployment (QFD) methodology to translate the voices of customers (VsOC) in stages into operations requirements. The emphasis is at the operational level.
Chan and Ming-Lu (2002)	It is a review paper highlighting the historical development of QFD, methodological development of technique, applications under the classification of different industries, working of some QFD organizations, and key readings – publications on QFD
Sahney et al. (2003)	Paper reports a study on educational institutions-industry interaction in Indian perspective using QFD model.
Sahney et al. (2004b)	An integrated approach of SERVQUAL and QFD model is applied to identify the gaps existing in quality education and customer requirements in today's modern education system.
Thakkar and Deshmukh (2006)	The paper presents use of quality function deployment (QFD) which prioritizes technical requirements and correlates them with various customers'/students' requirements for the present Indian context. Provides information about the severity of various technical requirements of competitive education.

the voice of all three requires attention both from the aspect of tangible (physical resource) and intangible (culture, lecture delivery) parameters. All these requirements are not of same level of importance from the point of view of customer's. Hence importance rating is required to specify from the perspective of customers. Through pair wise comparison importance rating is calculated considering a scale of 3 (most important), 2 (important), 1 (least important).

The QFD process is achieved by QFD matrix called the 'House of Quality' (HoQ). The dimensions of 'quality' are

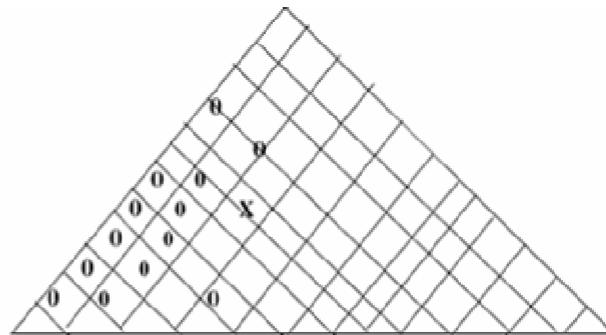
to be shown on one side of the matrix and 'processes' identified on the other side. The processes which affected quality in an institute are:

- Finance
- Total Involvement
- Co-operation
- Stakeholders Participation
- Course content/Design of Curriculum
- Sustainability
- Learning Environment

Table 2. QFD matrix for quality dimensions and enablers.

Correlation
 O-Positive
 X-Negative

Relationships
 9- Strong
 3- Medium
 1-Weak
 0-No relationship



Quality Dimensions	Characteristics (Codes)	Importance Rating			Enablers											
		Students	Staff	Employer	1	2	3	4	5	6	7	8	9	10	11	12
Organization & Governance (D1)	Education Policy	0.04	0.05	0.1579	9	3	0	0	3	3	3	1	3	0	0	0
	Leadership	0.32	0.20	0.1053	9	9	3	0	0	3	1	0	1	0	0	3
	Monitoring	0.04	0.10	0.0526	0	3	0	0	0	3	3	0	0	1	3	3
	Self-Assessment	0.04	0.10	0.1579	0	1	0	3	3	0	1	0	0	0	1	0
	Strategic Planning	0.28	0.30	0.2632	1	3	9	9	3	9	3	0	3	3	0	0
	Top Management Commitment	0.28	0.25	0.2632	3	9	9	3	1	3	0	0	1	1	0	0
Financial Resources (D2)	Fund	0.0833	0.2000	0.0714	9	0	0	0	0	3	1	0	0	3	0	0
	Expenditure per Student	0.0833	0.0667	0.2857	9	0	0	0	0	9	3	3	0	3	0	0
	Fee Structure	0.3333	0.0667	0.2143	9	0	0	0	0	3	1	0	3	0	0	0
	Cost of Course	0.4167	0.3333	0.0714	9	0	0	0	9	9	3	1	3	3	0	0
	Income Source	0.0833	0.3333	0.3571	9	0	0	0	0	3	1	0	0	0	0	0
Physical Resources (D3)	Computers	0.3256	0.3500	0.1667	9	3	3	9	3	3	9	1	9	3	1	1
	Infrastructure/ Building	0.1860	0.2250	0.2857	9	0	0	1	1	0	9	1	3	1	0	1
	Library Space /Management	0.1163	0.3750	0.1191	3	3	0	3	9	3	9	3	3	3	1	0
	Auditorium	0.0253	0.0250	0.0238	3	3	3	9	1	3	9	3	3	0	0	1
	Health Facilities	0.0465	0.1250	0.0476	9	3	3	0	0	0	0	3	0	0	0	0
	Hostel/ Mess	0.0920	0.0250	0.0476	9	3	3	0	0	0	1	1	1	0	0	1
	Class Room/ Offices	0.1163	0.3500	0.0952	1	3	3	3	3	3	9	3	3	1	1	1
	Sport Complex	0.0465	0.0750	0.0952	1	1	1	3	0	0	3	1	1	1	1	1
Transportation	0.0465	0.0500	0.1191	1	0	0	0	0	1	1	1	1	1	0	1	
Teaching - Learning Process (D4)	Organization Culture	0.0741	0.3333	0.1905	9	9	9	9	3	3	3	9	3	3	1	1
	Quality Assurance & Audit	0.0926	0.0888	0.0952	9	9	9	3	3	3	3	1	3	3	1	1
	Communication/Information	0.0556	0.0444	0.0952	1	3	3	3	1	1	1	1	1	3	1	1
	Course delivery	0.2057	0.3333	0.0476	1	3	3	3	9	3	3	1	1	9	1	1
	Course /Study material	0.1852	0.1111	0.0476	1	3	3	3	9	3	9	1	3	3	1	1
	Information Technology & Multi media	0.0556	0.0444	0.0238	1	1	1	1	9	3	3	1	3	3	1	1
	Quality in teaching & Learning	0.2057	0.3556	0.1191	1	3	3	9	9	9	9	3	3	3	3	1
Supplementary Process (D5)	Student/Teacher Assessment	0.3704	0.0888	0.0714	0	1	1	1	9	3	3	1	1	9	3	1
	Student Satisfaction	0.0926	0.2000	0.3095	0	1	1	3	3	3	3	1	3	9	3	3
	Industry Institute Interaction	0.0869	0.0800	0.2857	0	1	3	3	3	3	3	3	3	9	1	1
	R&D Culture	0.4348	0.3600	0.0476	1	3	3	3	9	1	9	1	9	9	3	1
	Journal available	0.0869	0.2400	0.0476	1	1	1	1	9	3	3	1	3	1	3	1
	Market Orientation /Focus	0.0869	0.0400	0.0952	0	1	1	0	0	0	0	1	1	3	0	1
Weightage:	Student				22.8	15.1	14.4	15.3	24.3	18.2	22.2	5.6	16.6	20.4	5.3	4.5
	Staff				21.2	13.3	12.9	13.7	18.7	15.3	19.4	5.7	12.9	16.3	4.9	3.9
Total	Employer				20.6	12.2	12.5	13.9	15.3	13.9	16.9	6.1	11.9	17.5	3.7	3.9
					64.6	40.6	39.8	42.9	58.3	47.4	58.5	17.4	41.4	54.2	13.9	12.3
Ranking				1	8	9	6	3	5	2	10	7	4	11	12	

- Partnership/Collaboration
- Innovative Culture
- Placement
- Staff Appraisal
- Discipline

According to the definition provided for each enabler,

the type of relationship between the enablers and dimension of quality was investigated. The most commonly used categories of 'strong', 'medium', 'weak' and no relationship with the values of 9, 3, 1 and 0 respectively were applied. In order to rank the specified enablers according to students, staff and employers. The impor-

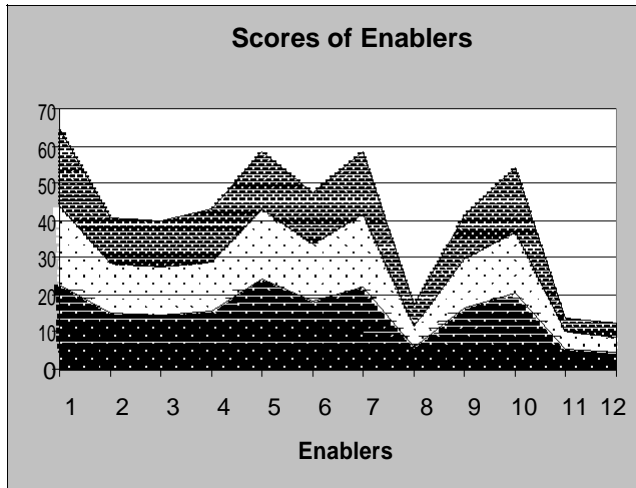


Figure1. Scores of enablers (Bar chart).

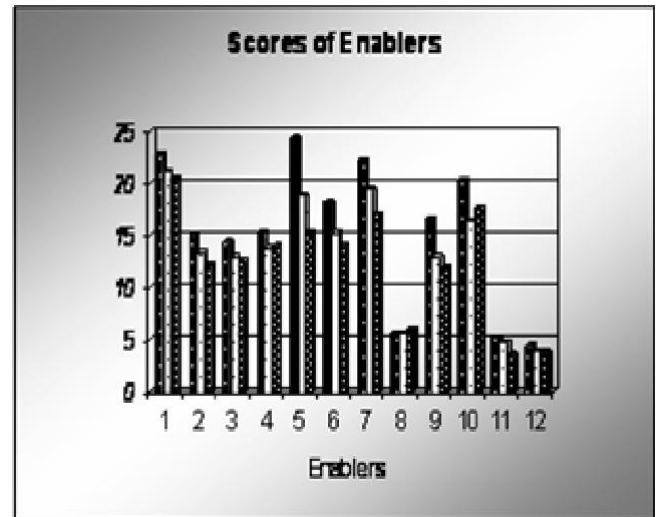


Figure 2. Scores of enablers (Area Block).

importance rating given by each group were considered in the Table 2, the importance rating were multiplied by weight and accumulated to give an overall score for each process.. The result of the QFD application shows very high score for 1st enablers; it can be attributed to the fact that finance is the most important aspect from the customer point of view for each process. Figure 1, bar chart and Figure 2, area block show the individual score of students, staff, and employer for each enabler.

Conclusion

This paper is an attempt of demonstrating the importance of TQM in education setting. The quality dimensions and enablers identified show the fundamental requirement and their relationship. The framework developed with the application of QFD in an educational institute will help in establishing the present improvement and set priorities for future scope of improvement. The utmost advantage of implementing the QFD approach in an educational institution is that it considers both tangible and intangibles aspects, and results can be utilized to have academic reforms in any educational institute. In the present work importance rating is calculated by pair wise comparison, on the basis of the literature review carried out from over 100 research paper, results of which are not discussed in this paper. This further opens the scope of future research by having a survey among the stakeholders and finding out the actual importance rating/ranking and validating those results with the present one.

REFERENCES

- Akao Y (1983) 'Quality Function Deployment', Quality Progress. Bennett DC (2001) 'Assessing quality in higher education', Liberal Education. 87(2): 40-46.
Booms BH, Nyquist J (1981) 'Analysing the customer/firm communic-

- ation component of the service marketing mix', in Donnelly, J.H. and George, W.R. (Ed.), Marketing Services, American Marketing Association, Chicago, IL: 172-177.
Bouchereau V, Rowlands H (2000) 'Methods and techniques to help quality function deployment (QFD)', Benchmarking: An International Journal. 7(1): 8-19.
Chan L, Ming-Lu W (2002) 'Quality function deployment: a literature review', Eur. J. Operational Res.. 143: 463-497.
Coate LE (1990) 'TQM at Oregon State University', J. Quality and Participation, 1990a(12): 90-101.
Ermer DS (1995) 'Using QFD becomes an educational experience for students and faculty', Quality Progress, 131-136.
Fiorenzo F, Marco T (1998) 'An application of quality function deployment to industrial training courses', Int. J. Quality & Reliability Manage.. 15(7): 753-768.
George WR (1977) 'The retailing of services: a challenging future', J. Retailing. 53(fall): 85-98.
Grant DM (2002) 'Measuring the dimensions of quality in higher education', Total Quality Management. 13(1): 123-132.
Gronroos C (1978) 'A service-oriented approach to marketing of services', Eur. J. Marketing. 12(8): 588-601.
Harris JW, Baggett JM (1992) (Eds) 'Quality Quest in the Academic Process', Samford University, Birmingham, AL, and GOAL/QPC, Methuen, MA.
Harvey L, Burrows A (1992) 'Empowering students', New Academic. 1(3): 2-3.
Hwang HB, Teo C (2001) 'Translating customers' voices into operations requirements - A QFD application in higher education', Int. J. Quality and Reliability Manage.. 18(2):195-225.
Hubbard DL (1994a) 'Can higher education learn from factories?' Quality Progress. 27(5): 93-97.
Hubbard DL (1994) 'Higher education: continuous quality improvement: making the transition to education', J. Academic Librarianship. 19(6): 401.
Jaraiedi M, Ritz D (1994), 'Total quality management applied to engg education', Quality Assurance in Education, 32-40.
Thakkar J, Deshmukh SG (2006), 'Total quality management (TQM) in self-financed technical institutions A quality function deployment (QFD) and force field analysis approach' Quality Assurance in Education. 14(1): 54-74.
Judd RC (1968) 'Similarities or differences in products and service retailing', J. Retailing. 43(Winter): 1-9.
Kells HR (1995) 'Creating a culture of evaluation and self-regulation in higher education organisations', Total Quality Management. 6(5/6): 457- 67.

- Lam K, Zhao X (1998) 'An application of quality function deployment to improve the quality of teaching', *Int. J. Quality and Reliability Manage.* 15(4): 389-413.
- Logotheitis N (1997) 'Managing for total quality from Deming to Taguchi and SPC', PHI Pvt. Ltd, New Delhi.
- Marshall SJ (1998) 'Professional development and quality in higher education institutions of the 21st century', *Australian J. Educ.* 42(3):321- 334.
- Mete BS (2004) 'Critical issues for TQM implementation in higher education', *The TQM Magazine*, 16 (6): 382-386.
- Owlia MS, Aspinwall EM (1996) 'Quality in higher education: a survey', *Total Quality Management.* 7(2):161-72.
- Pitman G, Motwani J, Cheng CH (1995) 'QFD application in an education setting: a pilot field study', *Int. J. Quality and Reliability Manage.*, 63-72.
- Rathmell JM (1966) 'What is meant by services?', *J. Marketing*, 30 Oct: 32-36.
- Reynolds PA (1990) 'Is an external examiner system an adequate guarantee of academic standards?' in LODER, C.P.J. (Ed.), *Quality Assurance and Accountability in Higher Education*, London, Kogan Page.
- Sasser WE (1976) 'Match supply and demand in service industries', *Harvard Business Review*, 54(11-12): 133-140.
- Shuell TJ, Lee CZ (1976) *Learning and Instruction*, Brooks-Cole Publishing, Monterey, CA.
- Singleton J (1974) 'Implications of education as a cultural transmission', in Spindler, G.D. (Ed.), *Education and Cultural Process: Toward an Anthropology of Education*, Holt, Rinehart and Winston, New York, NY, 26-38.
- Sahney S, Banwet DK, Karunes S (2004b) 'A SERVQUAL and QFD approach to total quality education: a student perspective', *Int. J. Productivity and Performance Manage.* 53(2):143-166.
- Sahney S, Banwet D, Karunes S (2003) 'Enhancing quality in education: application of quality function deployment – an industry perspective', *Work Study.* 52(6): 297-309.
- Spanbauer SJ (1987) 'Quality First in Education ... Why Not?', Fox Valley Technical College Foundation, Appleton, WI.
- Tranter P (2001) 'Measuring quality in higher education: a competency approach', *Quality in Higher Education.* 7(3): 191-199.
- Vonderembse MA, Raghunathan TS (1997) 'Quality function deployment's impact on product development', *Int. J. Quality Sci.* 2(4): 253-271.
- Zairi M, Youssef MA (1995) 'Quality function deployment: a main pillar for successful total quality management and product development', *Int. J. Quality & Reliability Manage.* 12(6) 9-23.
- Zeithaml VA, Parasuraman A, Berry LL (1985) 'Problems and strategies in services marketing', *J. Marketing*, 49(spring): 33-46.