Enhancing quality in education: application of quality function deployment – an industry perspective

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Keywords

Quality function deployment, SERVQUAL, Service quality assurance, Customer satisfaction

Abstract

Education is a service industry. It needs to adopt the techniques of other industries in measuring the quality of its services and the satisfaction of its customers. This paper reports on a study of educational institutes in India in terms of how well they meet the needs of local industrial customers. It involves the use of quality function deployment, and a range of statistical techniques, to design and analyze a questionnaire which results in a clear demonstration of a lack of satisfaction. The analysis also identifies those factors which should be specifically addressed to improve quality and customer satisfaction.

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Work Study
Volume 52 · Number 6 · 2003 · pp. 297-309

DOI 10.1108/00438020310496569

Introduction

Quality has become recognized as perhaps the key factor in determining long-term success and survival. This is true of mainstream manufacturing and service industries, and has even extended into areas such as education. The educational system in India has begun to realize the significance of a quality orientation and consequently is attempting to undertake research and development activity aimed at the provision of "better" services.

Education and business partnerships are increasingly being recognized as key elements of the higher education system. Companies can be identified as one of the key customers of education – one "traditional" interaction is the annual visits to educational institutions as part of the graduate recruitment round. The decision of a company as to which institution(s) to visit is based on a number of factors, but perhaps the most important is the perceived quality of the institution and the graduates it produces.

However, the transition from the world of higher education into the world of employment is not necessarily straightforward. The requirements of industry change ever more rapidly as industry becomes more flexible, adopts changing technologies and demands different skills and expertise. Educational curricula do not always keep pace with these changing requirements and educational institutions are often seen as failing to meet the needs of industry.

Since the customer is becoming more demanding in a gradually liberalizing Indian economy, educational institutes must improve the quality of their services in order to attract industrial customers and partners in an increasingly competitive marketplace.

This paper starts from a theoretical background, and goes on to outline the results of a study conducted amongst representatives of industry to obtain an industry perspective on the "quality" of selected educational institutions. Based on the literature review followed by a pilot study, a number of customer requirements and design characteristics were identified. The SERVQUAL concept was applied to identify the "quality gap" and determine the level of service quality. The quality function deployment technique was then used as an R&D tool to identify the set of minimum design characteristics/quality components

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that meet the requirements of industry as the external customer.

Theoretical background

Service quality

The last two decades have seen the increased acceptance and use of TQM and other quality frameworks across both manufacturing and service sectors, as quality has been recognized as an important factor for growth, survival and success (Quinn and Humble, 1993; Anderson *et al.*, 1994; Donaldson, 1995; Rust *et al.*, 1995). The word "quality" is a difficult and elusive term to define, since it has a wide variety of meanings and connotations to different people. The confusion over the numerous interpretations and perspectives of 'Quality' is particularly pronounced in the service sector (Galloway, 1996) due to the characteristics which tend to differentiate services from goods. These differences have lead to a lack of standardization in the use of the term "service quality", which means that "service quality" can vary considerably from one situation to the next, even within the same organization (Berry *et al.*, 1990). Thus, the measurement of service quality in specific service industries still remains a challenge (Babakus and Boller, 1992).

Most definitions of service quality are customer-centered (Galloway and Wearn, 1998), with customer satisfaction being seen as a function of perceived quality (Anderson and Sullivan, 1993), or perceived quality being a function of customer satisfaction (Parasuraman *et al.*, 1988). Service quality, as perceived by customers, involves a comparison of what they feel the service should be (expectation, E) with their judgment of the service they received (perceptions, P) (Grönroos, 1984; Parasuraman *et al.*, 1985; Zeithaml *et al.*, 1985).

Quality in education

As with services, the concept of quality when applied to higher education involves a number of interpretations (Bauer, 1992; Liaison Committee of Rectors' Conferences, 1993; Cheng and Tam, 1997; Pounder, 1999). Quality in education has been defined variously as:

- excellence in education (Peters and Waterman, 1982);
- value addition in education (Feigenbaum, 1951);
- fitness for purpose (Reynolds, 1986; Brennan *et al.*, 1992; Tang and Zairi, 1998);
- fitness of educational outcome and experience for use (Juran and Gryna, 1988);
- conformance of education output to planned goals, specifications and requirements (Gilmore, 1974; Crosby, 1979);
- defect avoidance in education process (Crosby, 1979); and
- meeting or exceeding customer's expectations of education (Parasuraman *et al.*, 1985).

Sahney *et al.* (2002) 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.

Empirical study

1. Objectives of the study

The objectives of the study were to:

- conduct a gap analysis for determination of service quality; and
- identify the design characteristics of a system that would meet the customer requirements of the industry as an external customer.

This involved, first, the comparison of the expectation score and the perception score for

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the various customer requirements and design characteristics, so as to identify the gap/service quality, and the satisfaction and dissatisfaction levels; and second, the identification of the design characteristics of a system that would meet the customer requirements of the industry, through use of the quality function deployment technique.

2. Methodology

The focus of the study has been on identifying the minimum set of design characteristics able to cover and provide for quality in education. The study is thus aimed at identifying and establishing linkages and relationships between the different items/components under two broad headings – the customer requirements and the design characteristics. The research undertaken is descriptive, diagnostic and exploratory in nature.

The scope of the study was confined to selected engineering and management institutions offering graduate and post-graduate degrees/diplomas in and around Delhi. The sample included "industry" as an external customer of the education system and was here confined to HR specialists from the industry that visited the engineering, technological and management institutions and campuses for placement. While selecting the institutions for the study, non-probability and judgmental sampling techniques were used. Within such institutions, random sampling was used to collect data.

3. Instrument developed for data collection:

The conceptual framework was developed on the basis of an extensive literature review. The literature review also helped to identify:

(1) the requirements of the different categories of customers; and
(2) those design characteristics (quality elements), which would lead to quality in education.

The customer requirements refer to the expectations of the customers from the educational system. The design characteristics refer to the design elements that make up a system and act upon or are acted upon by the transformation system. The design characteristics for this study refer to the quality components/elements. Based on the conceptual framework, a questionnaire was developed. A pilot study was carried out to test the validity and reliability of the instrument.

An attempt has been made to conceptualize and operationalize the quality construct from research works on service quality (Zeithaml *et al.*, 1985; Cronin and Taylor, 1992; 1994; Teas, 1993; 1994; Parasuraman *et al.*, 1994; Owlia and Aspinwall, 1998). Also customer requirements have been categorized under constructs such as content, attitude, competence, delivery and reliability. Similarly, the design characteristics/quality components have been conceptualized from the work of the "quality gurus". The terminology has been borrowed from Lewis and Smith (1994) and the items have been categorized under three constructs – management system, technical system and social system.

As far as the customer requirements were concerned, the tests for validity and reliability identified a total of 15 items, which got grouped under four factors/constructs for customer requirements and these factors were termed as tangibles, competence, delivery and attitude. The items so identified along with the various constructs may be seen in Table I.

As far as the design characteristics were concerned, the tests for validity and reliability identified a total of 20 items, which got grouped under three factors/constructs for design characteristics and these factors were termed as management system, technical system and social system. The items so identified along with the various constructs may be seen in Table II.

The items that emerged as valid and reliable were included in the final questionnaire, which was used for the main study. While the factors/constructs proved to be statistically significant and the validity could not be negated, for the final study, the scales for customer requirements and the design characteristics are considered as uni-dimensional with the items being considered as a single composite set of individual measures.

4. Data collection

The final questionnaire that was developed to capture quantitative data for the main study was administered to companies that visited the campuses for placement. The sample was

Table I Service quality/gap analysis for customer requirements

Items in each dimension	Perception (P) X	SD	α	Item total cor.	Expectation (E) X	SD	α	Item total cor.	Service quality P-E
A. Tangibles			0.760				0.946		
1. Appropriate Infrastructure for conducting placements	3.65	0.48		0.64	4.18	0.644		0.92	−0.53
2. Visually appealing environment	3.37	0.60		0.80	3.87	0.553		0.88	−0.50
3. Sufficient staff/support staff	3.43	0.66		0.70	4.00	0.56		0.92	−0.56
B. Competence			0.730				0.906		
4. Teaching expertise	3.71	0.58		0.37	4.37	0.49		0.61	−0.65
5. Core/basic knowledge	3.93	0.61		0.60	4.40	0.55		0.76	−0.46
6. Specialized/advanced knowledge	3.65	0.48		0.68	4.40	0.55		0.85	−0.75
7. Decision-making ability	3.65	0.65		0.64	4.37	0.49		0.85	−0.71
8. Communication skills	3.93	0.56		0.60	4.40	0.55		0.80	−0.46
9. Interpersonal/relationship-building skills	3.56	0.61		0.64	4.37	0.49		0.77	−0.81
C. Delivery			0.641				0.830		
10. Flexibility of knowledge being cross-disciplinary	3.46	0.50		0.33	4.34	0.60		0.83	−0.53
11. Courtesy	4.15	0.67		0.82	4.34	0.54		0.74	−0.59
12. Ease of access to the institution	3.84	0.57		0.70	4.31	0.59		0.72	−0.34
D. Attitude			0.771				0.865		
13. Risk-taking ability	3.46	0.56		0.60	4.00	0.56		0.81	−0.53
14. Desire to continue learning	3.75	0.67		0.82	4.34	0.54		0.75	−0.59
15. Ethics and morality	3.87	0.65		0.72	4.21	0.60		0.84	−0.34

Table II Perception scores and expectation scores of design characteristics

Construct	Perception scores Mean	Standard error	Expectation scores Mean	Standard error
Management system	3.5104	0.06	4.2326	0.06

(continued)

heterogeneous and comprised HR experts from various industries (such as automobiles, information technology, pharmaceuticals, fertilizers, banking) who visited campuses for student placements. A total of 32 responses were found to be complete and valid for analysis.

5. Analysis of data

Two software packages – SPSS v9.0 and Microsoft Excel were used for the analysis of the data. The statistical analysis used for the gap analysis was descriptive as well as inferential, and included multivariate techniques through correlation analysis. The quality function deployment technique along with correlation analysis was used to identify the minimum set of design elements (synonymous to the quality components), able to cover the customer requirements.

SERVQUAL and gap analysis

1. Introduction

The measurement of service quality has preoccupied service marketing researchers over the last decade. Interest in service quality has increased in recent years, with a growing literature applying TQM concepts in the service sector (Dotchin and Oakland, 1994; McDaniel and Louargand, 1994; Kettinger and Lee, 1995). However, the measurement of service quality often remains a challenge (Babakus and Boller, 1992; LeBlanc and Nguyen, 1997).

Service quality has been variously defined, although the main protagonists, Parasuraman *et al.* (1988) hold that it is "the ability of the organization to meet or exceed customer expectations". Service quality, as perceived by customers, involves a comparison of what they feel the service should be (expectation, E) with their judgment of the service they received (perception, P) (Grönroos, 1984; Parasuraman *et al.*, 1985; Zeithaml *et al.*, 1985). This alignment between customers' expectations and their perception of the service received is often referred to as "customer satisfaction".

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The most widely-used and tested service quality survey instrument has been SERVQUAL, based on the service quality "gap model", and developed by Parasuraman *et al.* (1988; 1991; 1993; 1994). This defines service quality as a function of the gap between customers expectations of a service and their perceptions of the actual service delivery by the organization. In this study, the SERVQUAL is used to measure service quality (here education quality). However, for this study, it has been modified to meet the specific needs of educational services.. While the terminology has been borrowed in the form of tangibles, reliability and competence, the items that these dimensions contain, have been changed to adapt to the needs of an educational service. Other dimensions have also been added. Parasuraman *et al.* (1988) do in fact suggest that some adaptation of their scale may be desirable when a particular service is investigated.

2. Gap analysis and findings

The differences in the gap scores (perception minus expectation, P – E = gap) for both the customer requirements and the design characteristics were studied for the sample of companies. The respondents were asked to respond on a scale of five, their degree of expectation, from "poor" to "excellent" and their degree of actual experience, again on a scale of five, from "poor" to "excellent". The mean and the standard deviation scores were calculated for the perception level (P) and the expectation levels (E) and then the gap (P – E) was calculated.

The adequacy of the scale for assessing the consumer's perceptions of service quality was examined in accordance with the recommendations provided in measurement literature (Nunnally, 1978). The scale's reliability, underlying dimensionality and predictive validity were analyzed. The scale's reliability was assessed by calculating the Cronbach's α; the underlying dimensionality was tested through an exploratory factor analysis conducted on each of the correlation matrices of the perception, expectation and gap scores; and the predictive validity was analyzed again through correlation analysis.

Customer requirements

The items in each construct/dimension were subjected to univariate analysis through the mean and standard deviation scores for perception and expectation. The item with the largest gap was item No. 9 – "Interpersonal/relationship building skills" while the item with the smallest gap was item No. 12 – "Base of access to the institution" and item No. 15 – "Ethics and morality". This indicated improvement in interpersonal/ relationship building skills (see Table I).

The coefficient α values for the perception sub-scales ranged from 0.641 to 0.771, while that of expectation sub-scales ranged from 0.830 to 0.946, indicating that the scale was internally consistent (Cronbach, 1951). The item-to-total correlation for individual performance items for both the perception as well as expectation sub-scales was greater than the 0.35 cut of value (Nunnally, 1978). The overall coefficient values were 0.6808 and 0.9062 for the perception and expectation scores respectively; quite consistent with those reported in Cronin and Taylor (1992) and Parasuraman *et al.* (1988).

For assessing the dimensionality of the scale, exploratory factor analysis was conducted on each of the correlation matrices of the perception, expectation and gap scores. A two-factor rotation was adopted and the data on the three correlation matrices produced very similar results with one factor accounting for most of the variation in item scores. This led to the conclusion that the scale should be treated as uni-dimensional with the items being considered as a single composite set of individual measures.

Further the principal component analysis of the data suggested a five-factor model for perception scores and a four-factor model for the expectation scores. However, it was observed that there was a lack of coherent structure in the items within the factors so identified. Scree plots for the whole data set for perception and expectation scores suggest that a single factor model would be most appropriate (see Figures 1 and 2). However, in keeping with the constructs so identified during the pilot study, the mean and standard error values on the perception and expectation scores assigned to the various customer requirements were calculated (see Table III). These values revealed that the validity of the model/construct could not be negated. It was statistically significant and the dimensions are valid constructs.

Figure 1 Scree plot: perception scores for customer requirements

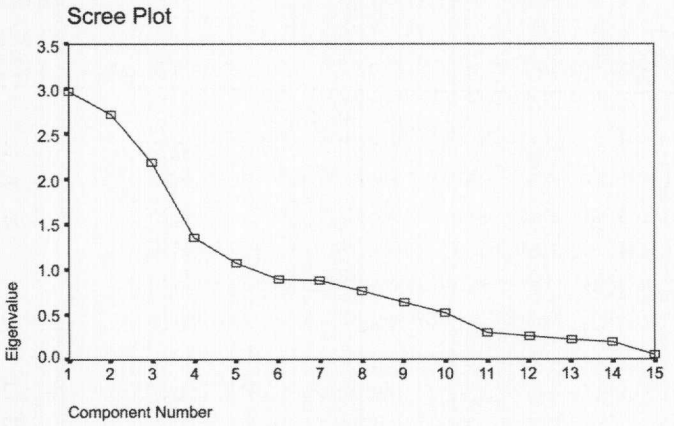


Figure 2 Scree plot: expectation scores for customer requirements

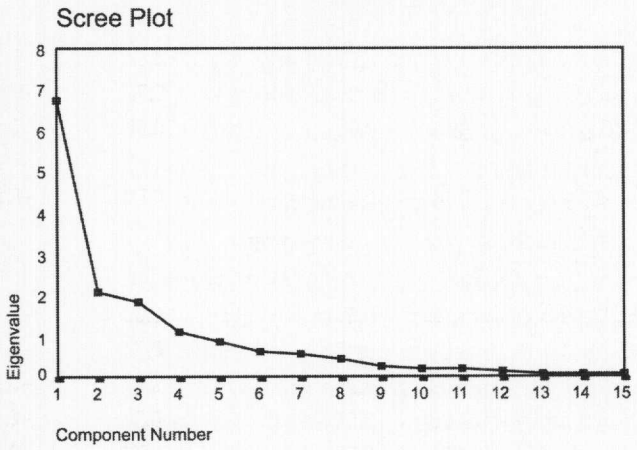


Table III Perception scores and expectation scores of customer requirements

	Perception scores		Expectation scores	
Construct	Mean	Standard error	Mean	Standard error
Tangibles	3.4896	0.07	4.0208	0.09
Competence	3.7448	0.06	4.3906	0.07
Attitude	3.6979	0.08	4.1875	0.08
Delivery	3.8229	0.06	4.3333	0.07

Design characteristics

Here again the items in each construct/dimension, were subjected to univariate analysis through the mean and standard deviation for the perception and expectation scores. The item with the largest gap and thereby, the most important area for improvement was item No. 11 – "Suitability and relevance of curriculum content". The item with the smallest gap was item No. 18 – Trustworthiness amongst all (see Table IV).

The coefficient α values for the perception sub-scales ranged from 0.896 to 0.920, while that of expectation sub-scales ranged from 0.770 to 0.827, indicating that the scale was internally consistent (Cronbach, 1951). The item-to-total correlation for individual performance items for both the perception as well as expectation sub-scales was greater than the 0.35 cut of value (Nunnally, 1978). The overall coefficient values were 0.8764 and 0.9462 for the perception and expectation scores respectively; quite consistent with those reported in Cronin and Taylor (1992) and Parasuraman *et al.* (1988).

For assessing the dimensionality of the scale, exploratory factor analysis was conducted on each of the correlation matrices of the perception, expectation and gap scores. A two-factor rotation was adopted. Data on the three correlation matrices produced very similar results with one factor accounting for most of the variation in item scores. This led to the conclusion that the scale should be treated as uni-dimensional with the items being considered as a single composite set of individual measures.

The principal component analysis of the data suggested a seven-factor model for perception scores and a four-factor model for the expectation scores. Here again, there was a lack of coherent structure in the items within the factors so identified. Scree plots for the whole data set for perception and expectation scores showed that a single factor model would be most appropriate (see Figures 3 and 4). However, keeping in line with the constructs so identified during the pilot study, the mean and standard error values on the perception and expectation scores assigned to the various design characteristics were calculated (see Table II). These values revealed that the validity of the model/construct could not be negated. It was statistically significant and the dimensions are valid constructs.

Quality function deployment

1. Introduction

Initiated by Shigeru Mizuno and Yogi Akao, in the 1960s, the quality function deployment technique, (QFD), has been established as an important quality tool in the design process (Akao, 1990; Mazur, 1994; Ekdahl and Gustafson, 1997). Being primarily a planning tool to fulfil customer expectations and requirements, it focuses on customer

Table IV Service quality/gap analysis for design characteristics

Items in each dimension	Perception (P) X	SD	α	Item total cor.	Expectation (E) X	SD	α	Item total cor.	Service quality P-E
A. Management system			0.920				0.827		
1. Clear and specific policies and procedures	4.28	0.45		0.92	3.75	0.62		0.72	–0.53
2. Strategic and operational planning	4.31	0.47		0.81	3.28	0.63		0.69	–1.03
3. Clearly specified teaching and learning strategies	4.34	0.48		0.79	3.68	0.64		0.61	–0.65
4. Clear organization structure and design	4.25	0.50		0.87	3.43	0.61		0.71	–0.81
5. Delegation of authority	4.03	0.53		0.68	3.12	0.60		0.54	–0.90
6. Machinery for evaluation and control	4.21	0.42		0.75	3.53	0.67		0.73	–0.68
7. Strict discipline	4.03	0.53		0.54	3.59	0.49		0.25	–0.43
8. Budget priorities	4.21	0.49		0.76	3.59	0.55		0.61	–0.62
9. Emphasis on continuous improvement	4.40	0.49		0.62	3.59	0.49		0.47	–0.81
B. Technical system			0.896				0.770		
10. Cross-functional collaboration	4.18	0.47		0.85	3.31	0.53		0.66	–0.87
11. Suitability and relevance of curriculum content	4.40	0.49		0.65	3.12	0.53		0.63	–1.09
12. Instructional arrangement	4.15	0.44		0.86	3.34	0.90		0.78	–0.81
13. Adaptive resource allocation	4.12	0.49		0.78	3.65	0.60		0.56	–0.46
14. Adequate and competent administrative staff	4.06	0.56		0.79	3.56	0.56		0.59	–0.50
C .Social system			0.903				0.789		
15. Differentiation – adaptive service for its customers	4.15	0.44		0.66	3.68	0.64		0.63	–0.46
16. Emphasis on training and development	4.25	0.56		0.84	3.28	0.45		0.74	–0.96
17. Participation and involvement	4.15	0.57		0.90	3.46	0.56		0.51	–0.68
18. Trustworthiness amongst all	4.15	0.62		0.84	3.78	0.65		0.51	–0.37
19. Well defined channels of communication	4.31	0.53		0.62	3.81	0.64		0.73	–0.50
20. Respect for people	4.21	0.42		0.75	3.71	0.77		0.72	–0.50

Figure 3 Scree plot: perception scores for design characteristics

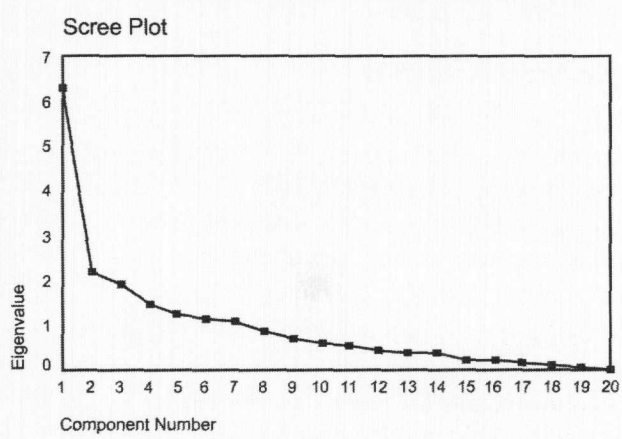
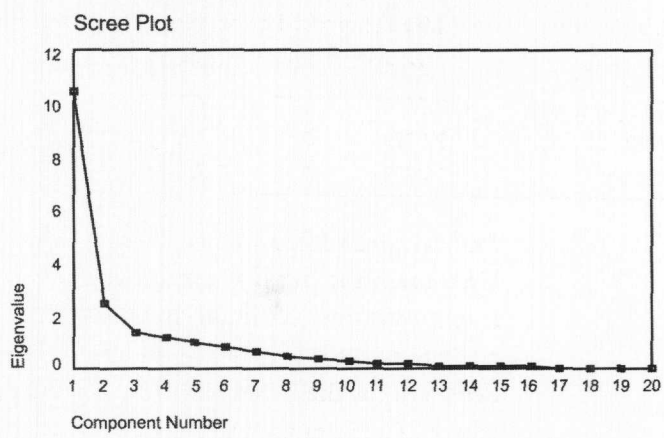


Figure 4 Scree plot: expectation scores for design characteristics



requirements and expectations, thus often being referred to as the "voice of the customer". It is a methodology for the development or deployment of features, attributes, or functions that give a product or service high quality. It may be defined as:

> A system for designing a product or a service based on customer demands and involving all members of the organization (Maddux, 1991).

The QFD presents a structured approach to integrating customer requirements with product and service design specifications.

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Starting with identifying and ranking the relative importance of the customer requirements, it goes on to identify the design characteristics/parameters that contribute to the meeting of those customer requirements; it then estimates the relationship between the customer requirements and the design characteristics; the relationship among the design characteristics; and finally to identify the set of design characteristics that best satisfy the customer requirements (Cohen, 1988; Hauser and Clausing, 1988; Pitman *et al.*, 1995).

2. Implementing the QFD technique

The QFD technique allows the use of charts and matrices. The traditional QFD technique is based on the premise: a set of items, "the whats" (customer requirements), is assigned to the rows. Similarly, a set of related items, "the hows" (design characteristics), is assigned to the columns. If the row items carry a numeric relative importance score and if the relation between the row items and the column items are expressed in numeric values, then the relative importance for the column items can also be calculated, and priorities can be set.

According to the independent scoring method, the technical importance rating w_j is given by the weighted column sum of each customer requirements by the quantified relationship values of technical characteristic ith, formed by substituting five points for strongly, three points for moderately and one point for weakly related items:

$$W_j = \sum_{i=1}^{m} d_i \cdot r_{ij},$$

where:

d_i = degree of importance of customer requirements, ith, $i = 1, 2, \ldots, m$;

r_{ij} = quantified relationship between customer requirement ith and technical characteristic jth; $i = 1, 2, \ldots, m$; $j = 1, 2, \ldots, n$;

w_j = technical importance rating for technical characteristics, jth, $j = 1.2 \ldots, n$;

For the purpose of the study, this traditional QFD technique has been altered and this usage could perhaps more properly be described as a "quasi-QFD" approach. The alterations made are explained as follows:

(1) The questionnaire comprised a set of questions, wherein the respondents were asked to rate on a scale of five (from high to low), the level of importance they assigned to each of the customer requirements/expectations. These values could be denoted as (d_i).

(2) The next section comprised a matrix structure, wherein each respondent was asked to relate each of the items in the rows, (customer requirements), to each of the items in the columns, (design characteristics). The relationship in terms of strong, moderate and weak, was to be expressed on a scale of five, three and one. These values could be denoted as (r_{ij}). If there was no relationship, it was denoted by a blank.

(3) Now, for each questionnaire, the degree of importance of customer requirements, (d_i) was multiplied with the quantified relationship between customer requirement ith and technical characteristic jth (r_{ij}).This was done to give a weighting to individual perceptions.

(4) The squares so calculated through step 4 were finally averaged and these were then added to arrive at absolute and relative rankings of the design characteristics.

(5) The different design characteristics were then correlated on the basis of scores calculated in step 4. The correlated pairs were identified and such pairs were plotted and denoted on the roof of the matrix.

3. Application of QFD

Against this backdrop, the QFD technique was used with the objectives of: identifying the presence of design characteristics and/or customer requirements related to each other through correlation; and identifying the minimum set of design characteristics able to cover all customer requirements. However, in this section, the scales for customer requirements and the design characteristics are considered as uni-dimensional with the items being considered as a single composite set of individual measures.

Keeping the traditional QFD technique in mind, with the rows representing the "customer requirements" (or "what"), and the columns representing the "design characteristics" (or "how"), a matrix was

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framed. The data was analyzed through the quasi-QFD technique explained in the previous section.

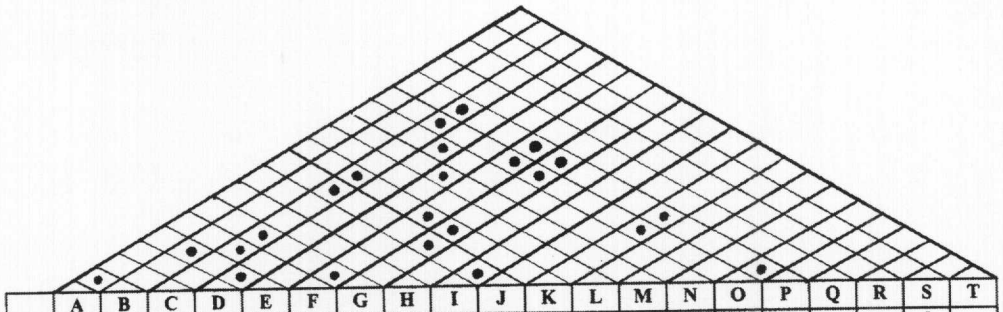
The customer requirement attributes numbered 15 while the design characteristic attributes numbered 20. These were coded (see Figure 5).

The absolute values were computed for each column, representing the design characteristics (denoted as AR). These design characteristics were then ranked relatively (denoted as RR) and the items with the first ten ranks were identified (see Table V).

The interrelationship between the different design characteristics was determined through a correlation analysis. The correlated pairs with alpha value of more than 0.60 were identified (see Table VI). These were as follows:

{A, B}, {B, E}, {C, F}, {C, G}, {C, J}, {C, K}, {C, O}, {C, P}, {D, E}, {D, N}, {E, M}, {F, G}, {F, K}, {F, O}, {F, P},

Figure 5 QFD matrix – industry



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	11	3				4		18	12	9		14	6	2	11				5	
2								12	7						2		5			
3	15	9		11	5	8	2	13	11	10		2	9	18	12		6		9	
4	3	9	23	5	10	11	2	2	15	13	11	5	11	3	16	16	12	8	12	6
5	10	2	20			12	4		11	18	16	10	3		12	7			9	
6	10	4	20			12	3		12	7	9	10	3		17	11			11	
7	8	2	16			9	2		11	3	10	2			13	9	4		10	
8	2		15			11	2		11	15	8	3			12	9	13		17	
9	8	7	18			6	2		12	16	4	2			9	8	13		13	16
10	2	2	14			7	2		11	4	9	3			11	12		2	6	
11	2	1	4						18	13	4	2			9	1	2		8	
12	2					7			5						3		2	15	13	7
13	15	6	17			9	3		10	20	11	9	2		16	12			9	
14	5			6	2				2	2			2	11	11	2			13	17
15	19	9		11	3			7				7		7	8				11	15
AR	112	54	147	33	20	96	22	52	148	130	82	69	36	41	162	87	57	25	146	61
RR	6	13	3	17	20	7	19	14	2	5	9	10	16	15	1	8	12	18	4	11

Codes and items

A	Clear and specific policies and procedures	H	Budget priorities	O	Differentiation
B	Strategic and operational plans	I	Emphasis on continuous improvement	P	Emphasis on training and development
C	Clearly specified teaching and learning strategies	J	Cross-functional collaboration	Q	Participation and involvement
D	Clear organization structure and design	K	Suitability and relevance of curriculum	R	Trustworthiness amongst all
E	Delegation of authority	L	Instructional arrangement	S	Well defined channels of comm.
F	Machinery for evaluation	M	Adaptive resource allocation	T	Respect for people
G	Strict discipline	N	Adequate and competent administrative staff		

1	Infrastructure for conducting placements	6	Specialized/advanced knowledge in students	11	Desire to continue learning in students
2	Visually appealing environment	7	Decision making ability in students	12	Ethics and morality
3	Sufficient administrative/support staff	8	Communication skills in students	13	Flexibility of knowledge being cross-disciplinary
4	Teaching expertise	9	Interpersonal skills in students	14	Courteous behavior
5	Core/basic knowledge in students	10	Risk taking ability in students	15	Ease of access to institution

Table V Relative ranking of items (industry)

Relative rank	Items
I	Differentiation
II	Emphasis on continuous improvement
III	Clearly specified teaching and learning strategies
IV	Well defined channels of communication
V	Cross-functional collaboration
VI	Clear and specific policies and procedures
VII	Machinery for evaluation and control
VIII	Emphasis on training and development
IX	Suitability and relevance of curriculum content
X	Instructional arrangement

{G, J, {G, K}, {G, O}, {G, P}, {I, J}, {K, O}, {K, P}, {O, P}

These were plotted (·) on the roof of the matrix and are specified in Table VII.

First, the QFD technique helped identify in terms of relative ranking the design characteristics. Second, the correlation analysis helped identify the minimum set of design characteristics necessary to meet the various customer requirements. The design characteristics so identified through these methods are as follows:

- Clear and specific policies and procedures;
- Emphasis on continuous improvement;
- Strategic and operational planning;
- Crossffunctional collaboration;
- Clearly specified teaching and learning strategies;
- Suitability and relevance of curriculum content;
- Clear organizational structure and design,
- Adaptive resource allocation (as in contingencies);

Table VII Important items after correlation (industry)

Codes	Items
A	Clear and specific policies and procedures
B	Strategic and operational planning
C	Clearly specified teaching and learning strategies
D	Clear organizational structure and design
E	Delegation of authority
F	Machinery for evaluation and control
G	Strict discipline
I	Emphasis on continuous improvement
J	Cross-functional collaboration
K	Suitability and relevance of curriculum content
M	Adaptive resource allocation
N	Adequate and competent administrative staff
O	Differentiation – adaptive service for its customers
P	Emphasis on training and development for its employees

Table VI Important pairs after correlation (industry)

Codes	Items	
A-B	Clear and specific policies and procedures	Strategic and operational planning
B-E	Strategic and operational planning	Delegation of authority
C-F	Clearly specified teaching and learning strategies	Machinery for evaluation and control
C-G	Clearly specified teaching and learning strategies	Strict discipline
C-J	Clearly specified teaching and learning strategies	Cross-functional collaboration
C-K	Clearly specified teaching and learning strategies	Suitability and relevance of curriculum content
C-O	Clearly specified teaching and learning strategies	Differentiation
C-P	Clearly specified teaching and learning strategies	Emphasis on training and development
D-E	Clear organizational structure and design	Delegation of authority
D-N	Clear organizational structure and design	Adequate and competent administrative staff
E-M	Delegation of authority	Adaptive resource allocation
F-G	Machinery for evaluation and control	Strict discipline
F-K	Machinery for evaluation and control	Suitability and relevance of curriculum content
F-O	Machinery for evaluation and control	Differentiation
F-P	Machinery for evaluation and control	Emphasis on training and development
G-J	Strict discipline	Cross-functional collaboration
G-K	Strict discipline	Suitability and relevance of curriculum content
G-O	Strict discipline	Differentiation
G-P	Strict discipline	Emphasis on training and development
I-J	Emphasis on continuous improvement	Cross-functional collaboration
K-O	Suitability and relevance of curriculum content	Differentiation
K-P	Suitability and relevance of curriculum content	Emphasis on training and development
O-P	Differentiation	Emphasis on training and development

- Delegation of authority/power distribution;
- Adequate and competent administrative staff;
- Instructional arrangement-adequate infrastructure and facilities;
- Machinery for evaluation and control;
- Differentiation adaptive service for its customers;
- Strict discipline;
- Emphasis on training and development for employees; and
- Well defined channels of communication.

Summary and relevance of findings

This study was aimed at conducting a gap analysis for determination of service quality (here quality of education), and identifying the design characteristics of a system that would meet the customer requirements of the industry as an external customer. A literature review followed by a pilot study helped formulate a questionnaire. The statistical analysis was descriptive as well as inferential, and included multivariate techniques through correlation analysis. The scales for predictive validity, reliability and dimensionality was analyzed and univariate and bivariate analysis was carried out to determine the gaps in the service (here educational) quality.

The gap analysis helped determine the service quality, in other words the extent of satisfaction/dissatisfaction levels. It is noteworthy that negative scores were obtained for all the categories of customers with the expectation levels being higher than their perception scores. The results obtained led to the conclusion that there was a great deal of dissatisfaction with the educational system. Companies were dissatisfied with the performance of the institutions and with the students graduating from them. This indicates the need for improvement of the entire system.

The design characteristics/quality components and their relationship to the different customer requirements were analyzed through the QFD technique and correlation analysis. The minimum set of design characteristics able to meet the various customer requirements was identified. These design characteristics may be termed as indices for "total quality education", with parameters that can be used as performance measures for the system. Such design characteristics/parameters, when implemented, would help meet the requirements of industry as customer/stakeholder.

The findings from this study should act as a "wake up call" to the educational institutes involved. They show that increasingly demanding customers have a significant level of dissatisfaction with the quality of education provided. Organizations that recruit graduating students are important customers of the services being delivered by these educational institutes. This study identifies attributes that need to be addressed to enhance quality and improve customer satisfaction.

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