Total Quality Management Aspects of Implementation and Performance Investigation with a Focus on Higher Education by Using QFD & Statics cal Analysis in Mechanical Engineering - A Case of Private Institute

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ABSTRACT
Education is of numerous types and patterns. There is for example, the arts education, the scientific education, the religious education, the physical education. In India, as in other countries, much stress has been laid on the promotion of technical education since the attainment of independence. India's economic ills are sought to be overcome through a process of Industrialization for which, in turn, technical education is very essential. In other words, technical education is a vital prelude to India's property. The scope of technical education is very comprehensive. It incorporates within itself all subjects of study in engineering and technology. Civil engineering, Mechanical engineering, Electrical engineering, Mining engineering, Aeronautical engineering, Metallurgical engineering, Industrial engineering, Chemical engineering, Agricultural engineering, Production engineering, and a host of other fields of engineering form part of technical education."Quality in technical education is a complex concept that has eluded clear definition" . There are a variety of stakeholders in higher education including students, employers, teaching and non-teaching staff government and its funding agencies, accreditors, valuators', auditors, and assessors (including professional bodies).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. The present work enlightens same path, so as to fulfil the demands of market and to improve quality of education in the present work some quality tools such as LINEAR PROGRAMMING, TQM, QUALITY FUNCTION DEPLOYMENT, with chi square testing and mat lab, have been used. Basic primary tool used is LPP which helps in converting demand of customer to action. It helps in understanding unspoken needs of customer which are desperately needed to be fulfilled. In this improvement work main focus was on improvement of labs and teaching staff, for maintenance of labs & improvement in teaching, use of quality circle is stressed with concept of TPM and Kaizen approach. Most interesting thing of using these tools was that they helped in achievement of desired target without much added resource, only refinement of procedure; moreover maintenance helps in gaining knowledge with saving extra expenditure. This also helps in up gradation of quality of products which satisfies external customer.

Key words: Chi Square Testing, LPP, MATLAB, Statics cal Analysis

I INTRODUCTION

India's higher education system is the world's third largest in terms of students, next to China and the United States. Unlike China, however, India has the advantage of English being the primary language of higher education and research. India educates approximately11 per cent of its youth in higher education as compared to 20 per cent in China. The main governing body at the tertiary level is the University Grants Commission (India), which enforces its standards, advises the government, and helps coordinate between the centre and the state. Universities and its constituent colleges are the main institutes of higher education in India. At present in 2011, there are 227 government-recognized Universities in India. Out of them 20 are central universities, 109 are deemed universities and 11 are Open Universities and rest are state universities. Most of these universities in India have affiliating colleges where undergraduate courses are being taught. According to the Department of higher Education government of India, 16,885 colleges, including 1800 exclusive women's colleges functioning under these universities and institutions and there are 4.57 lakh teachers and 99.54 lakh students in various higher education institutes in India. Apart from these higher education institutes there are several private institutes in India that offer various professional courses in India. Distance learning is also a feature of the Indian higher education system.

II REVIEW OF LITERATURE

All of the research review supports the hypothesis that student performance depends on different socio-economic, psychological, environmental factors. The finding of research studies focuses that student performance is affected by different factors such as learning abilities. The new paradigm about learning assumes that all students can and should learn at higher levels but it should not be considered as constraint because there are other factors like race and gender that can affect student's performance. Some of the researchers even tried to explain the link between students achievement, economic circumstances and the risk of becoming a drop-out that proved to be positive (Goldman N., Haney W., and Koffler S.,1988, Pallas A., Natriello G., McDill E., 1989, Levin H., 1986) B.A. Chandrashekhar and A. Mishaeloudis (2001), explained the effects of age, qualification distance from learning place etc. on student performance. The performance of students on the module is not affected by such factors as age, sex and place of residence but is associated with qualification in quantitative subjects. It is also found that those who live near the university perform better than other students. Yvonne Beaumont Walters, kola soyibo,

(1998) further elaborated that student performance is very much dependent on SEB (socio economic back ground)as per their statement, "High school students' level of performance is with statistically significant differences, linked to their gender, grade level, school location, school type, student type and socio-economic background (SEB)."Kirby, Winston et al. (2002) focused on student's impatience (his time-discount behaviour) that influences his own academic performance. Goethe found out that weak students do better when grouped with other weak students. (As implied by Zajonc's analysis of older siblings (1976) it shows that students' performance improves if they are with the students of their own kind. There are often different results by gender, as in Hoxby's K-12 results (2000); Sacerdote (2001) finds that grades are higher when students have unusually academically strong roommates. The results of Zimmerman (1999, 2001) were somewhat contradictory to Goethe results but again it proved that students performance depends on number of different factors, it says that weak peers might reduce the grades of middling or strong students.

(i) Read already published work in the same field.
(ii) Goggling on the topic of your research work.
(iii) Attend conferences, workshops and symposiums on the same fields or on related counterparts.
(iv) Understand the scientific terms and jargon related to your research work.

III METHODOLOGY

Statistical techniques including regression analysis were used as a methodology. Data collected was of primary nature through a well-defined questionnaire. A sample of private college students was taken where these variables were recognized and response was clear and understandable. Public sector educational institutions were not the focus of the study. A sample of 30 students was taken from a group of colleges. Students were grouped in a classroom they were briefed clearly about the questionnaire and it took on average half an hour to fill this questionnaire. Selection of students was at random. Out of these students only those were selected at random who were voluntarily willing to fill the questionnaires. The data was collected using a questionnaire administrated by the Research team in the 3rd month of 3rd year. The questionnaire dealt mainly with student profile based on his attitude towards Study, Strictness, Attendance, Age, Previous academic achievements, Daily life, etc. All 6 questionnaires were filled with the response rate of 100%.

The sample age composition was from 18 years to 22 years of age at maximum because Rajiv Gandhi Technical University of does not allow students over 22 years of age to be admitted in graduate classes.

Basic Ideology

Student ⟶ INSTITUTE ⟶ Finished (O/P)
I/P Product

(a) Linear Programming-

Linear programming (LP) techniques consist of a sequence of steps that will lead to an optimal solution to problems, in cases where an optimum exists. There are a number of different linear programming techniques; some are special-purpose (i.e., used to find solutions for specific types of problems) and others are more general in scope. This supplement covers the two general-purpose solution techniques: graphical linear programming and computer solutions. Graphical linear programming provides a visual portrayal of many of the important concepts of linear programming. However, it is limited to problems with only two variables. In practice, computers are used to obtain solutions for problems, some of which involve a large number of variables.

Linear programming is a powerful quantitative tool used by operations managers and other managers to obtain optimal solutions to problems that involve restrictions or limitations, such as the available materials, budgets, and labour and machine time. These problems are referred to as constrained optimization problems. There are numerous examples of linear programming applications to such problems, including:

(i) Establishing locations for emergency equipment and personnel that will minimize response time
(ii) Determining optimal schedules for airlines for planes, pilots, and ground personnel
(iii) Developing financial plans
(iv) Determining optimal blends of animal feed mixes
(v) Determining optimal diet plans
(vi) Identifying the best set of worker–job assignments
(vii) Developing optimal production schedules
(viii) Developing shipping plans that will minimize shipping costs
(ix) Identifying the optimal mix of products in a factory

(b) Linear Programming Models-

Linear programming models are mathematical representations of constrained optimization problems. These models have certain characteristics in common. Knowledge of these characteristics enables us to recognize problems that can be solved using linear programming. In addition, it also can help us formulate LP models. The characteristics can be grouped into two categories: components and assumptions. First, let's consider the components. Four components provide the structure of a linear programming model:

(i) Objective
(ii) Decision variables
(iii) Constraints
(iv) Parameters.

Linear programming algorithms require that a single goal or objective, such as the maximization of profits, be specified. The two general types of objectives are maximization and minimization. A maximization objective might involve profits, revenues, efficiency, or rate of return. Conversely, a minimization objective might involve cost, time, distance travelled, or scrap. The objective function is a mathematical expression that can be used to determine the total profit (or cost, etc., depending on the objective) for a given solution. Decision variables represent choices available to the decision maker in terms of amounts of either inputs or outputs. For example, some

problems require choosing a combination of inputs to minimize total costs, while others require selecting a combination of outputs to maximize profits or revenues.

The Model-

Simple linear regression analysis was used to test the hypothesis- Coefficients are b1, b2, b3, b4, b5, b6

The Data-

A student profile was developed on the basis of information and data collected through survey to explain student's attitude towards explanatory variables. The first variable "attendance in class" explains student's attitude towards class attendance, which reflects his level of interest in learning. Student's attitude towards time management for studies is reflected through number of hours spent in study after college, is taken as second variable. Third variable of the study is family income that reflects the comforts and facilities available for study. The fourth variable is "Question banks/reference book", that is, how many books a student refers for his studies. The fifth variable is "type of study" which shows whether the student studies in a group or studies individually. The last variable shows the residential status of student, describing whether the student is a Day scholar or a Hosteler.

Student's performance in intermediate examination is taken as dependent variable and rest of the variables, which construct student profile, are taken as independent variables.

Table 1 explains expected relation of dependent variables these expected relations are also myths pervading in Indian society so the results of this study are to accept or reject these myths. The table explains students performance due to student's attitude towards studies based on student's profile developed on the basis of information and data collected. It is assumed that student is still carrying his profile as it is.

Table 1
Expected Relationship

VARIABLE	EXPECTED RELATIONSHIP	EXPLANATION
Attendance in Class	Positive	A regular student is more serious in studies
Family Income	Positive	It is assumed affluence gives more facilities to learn
Study hours per day after College	Positive	It is assumed that more study hours results in good grade/division/ performance
Books Referred	Positive	More books referred results in better grasp of the concept
Type of Study	Positive	Group study results in healthier studying environment, hence better result
Hosteler/Day Scholar	Positive	Hostelers are found to be more dedicated in their studies

Exogenous (Independent) Variable-

ATT= Attendance % age, it represents how many classes student attends in a week and that shows seriousness and attitude towards studies.

SH= Study hours, it represents how many hours a student spends on study after attending the class in college again it shows how much serious the student takes the studies.

FI= family income, it represents the level of affluence of the student, how much facilities, comfort the student can acquire.

BR= Book reference, it represents the quality of knowledge student is gaining, whether he is using a quality book or only a question bank.

TS= Type of Study, it represents the type of study like group or individual in which he study with many suggestion or study individual.

RS= Residential status, it represents the status that whether he is a day scholar or hosteller so that how much beneficial time he is getting.

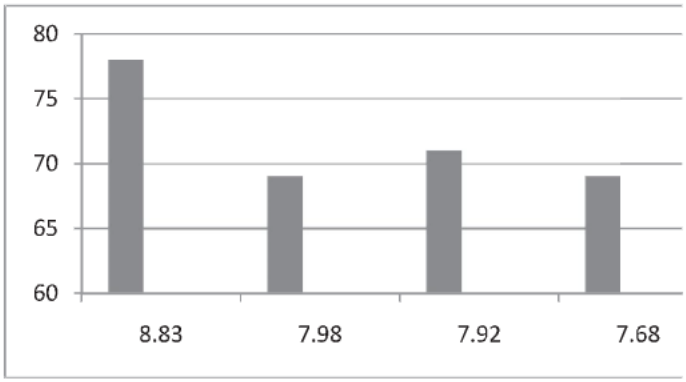
Endogenous (dependent) variables

Y= Student's performance

IV DATA ANALYSIS

Table 2
Attendance CGPA Relationship

Students	CGPA	Attendance (in %)	Study hours	Result
Student 1	8.83	78	6	Pass
Student 2	7.98	69	4	Pass
Student 3	7.92	71	4	Pass
Student 4	7.68	69	4	Pass
Student 5	7.68	66	3	Pass
Student 6	7.66	61	3	Pass
Student 7	7.40	59	2	Pass
Student 8	7.38	65	3	Pass
Student 9	7.29	63	2	Pass
Student 10	7.15	58	3	Pass



Graph 1 – Attendance to CGA relationship

Graph 2 – Study hours

Graph 3
Ratio of CGPA Distribution among students

Table 2
Comparison of Expected Results and Results of the Study

VARIABLE	EXPECTED RELATIONSHIP	EXPLANATION	Result
Attendance in Class	Positive	A regular student is more serious in studies	Positive
CGPA	Positive	Student with good CGPA perform more good in next exam.	Positive
Study hours per day after College	Positive	It is assumed that more study hours results in good grade/division/ performance	Positive

V RESULT VALIDATION

(a) CHI Square Solution for Validation of Result

Student	A	B	C	D	E	Total
Attendance	73.5	70	63.5	62	60.5	329.5
Study hr.	5	4	3	2.5	2.5	17
CGPA	8.38	7.8	7.67	7.39	7.22	38.46
Total	86.88	81.8	74.17	71.89	70.22	384.96

(b) Chi Square (X^2) Calculations

$(X^2) = (o-e)^2/e$ d.o.f.=(m-1)/n-1)

Expected frequency calculated as $E_r, E_c = (n_r * n_c)/N$

o	e	(o-e)	$(o-e)^2$	$(o-e)^2/e$
73.5	74.36	-0.86	0.7396	$9.946*10^{-3}$
70	70.01	-0.01	0.0001	$1.428*10^{-6}$
63.5	63.48	0.02	0.0004	$6.299*10^{-6}$
62	61.53	0.47	0.2209	$3.59*10^{-3}$
60.5	60.1	0.4	0.16	$2.66*10^{-3}$
5	3.83	1.17	1.3689	0.357
4	3.61	0.39	0.1521	0.0464
3	3.28	-0.28	0.0784	0.0240
2.5	3.17	-0.67	0.4489	0.1416
2.5	3.1	-0.6	0.36	0.1161
8.38	8.68	-0.3	0.09	0.0108
7.8	8.17	-0.37	0.1369	0.0168
7.67	7.41	0.26	0.0676	$9.123*10^{-3}$
7.39	7.18	0.21	0.0441	$6.14*10^{-3}$
7.22	7.01	0.21	0.0414	$6.29*10^{-3}$

$$(X^2) = \frac{(o-e)^2}{e} = 0750 < TABULATED\ VALUE$$

Therefore Hypotheses is accepted

(c) Analysis to increase the performance of students

Max. performance $(Z_{max}) = x_1 + x_2 + x_3$

$x_1 = Attendance, x_2 = Study\ hours, x_3 = CGPA$

$x_1 \leq 10$

$x_2 \leq 10$

$x_3 \leq 10$

	C_j	1	1	1	0	0	0		
C_B	B.V.	x_1	x_2	x_3	s_1	s_2	s_3	b	θ
0	s_1	(1)	0	0	1	0	0	10	10←
0	s_2	0	1	0	0	1	0	10	∞
0	s_3	0	0	1	0	0	1	10	∞
	Z_j	0	0	0	0	0	0	0	
	$C_j - Z_j$	1 ↑	1	1	0	0	0		

	C_j	1	1	1	0	0	0		
C_B	B.V.	x_1	x_2	x_3	s_1	s_2	s_3	b	θ
1	x_1	1	0	0	1	0	0	10	∞
0	s_2	0	(1)	0	0	1	0	10	10 ←
0	s_3	0	0	1	0	0	1	10	∞
	Z_j	1	0	0	0	0	0	10	
	$C_j - Z_j$	0	1 ↑	1	0	0	0		

	C_j	1	1	1	0	0	0		
C_B	B.V.	x_1	x_2	x_3	s_1	s_2	s_3	b	θ
1	x_1	1	0	0	1	0	0	10	∞
1	x_2	0	1	0	0	1	0	10	∞
0	s_3	0	0	(1)	0	0	1	10	10 ←
	Z_j	1	1	0	0	0	0	20	
	$C_j - Z_j$	0	0	1 ↑	0	0	0		

	C_j	1	1	1	0	0	0	
C_B	B.V.	x_1	x_2	x_3	s_1	s_2	s_3	b
1	x_1	1	0	0	1	0	0	10
1	x_2	0	1	0	0	1	0	10
1	x_3	0	0	(1)	0	0	1	10
	Z_j	1	1	1	0	0	0	30
	$C_j - Z_j$	0	0	0	0	0	0	

Value obtained=$x_1 = x_2 = x_3 = 10$

VI CONCLUSION

The objective of this study was to quantify the relationship between the different factors that are considered responsible for affecting the student performance along with providing base for further research regarding student performance. Selecting these combination of variables do have some objectives like, it was expected that relationship between dependent variable and student attitude towards attendance is positive because regularity shows the effort and seriousness of student about his or her studies. It is believed that the relationship between dependent variable and student family income is positive because money can buy you all comfort that you need to concentrate on your studies but the result could not prove this relation because student belonging to more prosperous/affluent family do not give proper weightage to studies. Although this value is very small but still it reflects the insignificance of affluence that is affluence cannot make a student serious about his studies or if a student want to study then affluence is not a prerequisite. It still requires more research to explain the phenomenon. It is still believed strongly that relationship between dependent variable and student attitude towards time allocation for per day after college are positively related but the result could not prove this relation because more study hours are not significant as far as student performance is concerned. It may depend on intelligence level, intellect, memory or method or learning of the student although this value is very small yet it reflects personal characteristics of student. Further research is required to explore this relation. It is believed that book reference also has great effect on performance of students that if students are referring to books it helps in increase of concepts and deep knowledge about the topic, and if one is studying form question banks then he cannot grasp more knowledge; yes but he can touch every topic with little knowledge. Selecting a type of study .i.e. between Group and Individual affects the student performance. It is believed that Group studies have more impact over individual studies. If a student is studying in group he is scoring better marks that him who is studying individually. One more important attribute is Day scholar or Hosteller. It is found that student that are Hosteller perform better than Day scholar.

REFERENCES

[1] Barnetson, B., &Cutright, M. (2000). Performance indicators as conceptual technologies. Higher Education,

[2] B.A. Chandrashekhar and A. Mishaeloudis (2001)

[3] Akao Y (1983) 'Quality Function Deployment', Quality Progress.Bennett DC (2001) 'Assessing quality in higher education', Liberal Education. 87(2): 40-46.

[4] Bouchereau V, Rowlands H (2000) 'Methods and techniques to help quality function deployment (QFD)', Benchmarking: An International Journal. 7(1): 8-19.

[5] Chan L, Ming-Lu W (2002) 'Quality function deployment: a literature review', Eur. J. Operational Res... 143: 463-497.

[6] Coate LE (1990)"TQM at Oregon State University", J. Quality and Participation, 1990a(12): 90-101

[7] Ermer DS (1995) 'Using QFD becomes an educational experience for students and faculty', Quality Progress, 131-136.

[8] Fiorenzo F, Marco T (1998) 'An application of quality function deployment to industrial training courses', Int. J. Quality & Reliability Manage.. 15(7): 753-768.

[9] George WR (1977) 'The retailing of services: a challenging future', J.Retailing. 53(fall): 85-98.

[10] (Goldman N., Haney W., and Koffler S.,1988, Pallas A., Natriello G., McDill E., 1989, Levin H., 1986)

[11] 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.

[12] Judd RC (1968) 'Similarities or differences in products and service retailing, J. Retailing. 43(Winter): 1-9.

[13] Kells HR (1995) 'Creating a culture of evaluation and self-regulation in higher education organisations', Total Quality Management. 6(5/6):457- 67

[14] Soni Abhishek (2013)'Improvement of Quality of Technical Institute through QFD'. International J. of Multidispl. Research & Advcs. in Engg.(IJMRAE), Vol. 5, No. IV (October 2013), pp. 133-149

[15] Sahney S, Banwet D, Karunes S (2003) 'Enhancing quality in education: application of quality function deployment – an industryperspective', Work Study. 52(6): 297-309.

[16] 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.

[17] Vonderembse MA, Raghunathan TS (1997) 'Quality function deployment's impact on product development', Int. J. Quality Sci...2(4): 253-271.

[18] Grant DM (2002) 'Measuring the dimensions of quality in higher education, Total Quality Management. 13(1): 123-132

[19] Gronroos C (1978) 'A service-oriented approach to marketing of services', Eur. J. Marketing. 12(8): 588-601.

[20] 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.

[21] Hwarng 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.

[22] Hubbard DL (1994a) 'Can higher education learn from factories?' Quality Progress. 27(5): 93-97.

[23] Hubbard DL (1994) 'Higher education: continuous quality improvement: making the transition to education', J. Academic Librarianship. 19(6): 401.

[24] Jaraiedi M, Ritz D (1994), 'Total quality management applied to engg education', Quality Assurance in Education, 32-40.

[25] Soni Abhishek(2013) ' Total Quality Management in Educational Process Focused on Quality Improvement of Institute with Customer Satisfaction & Teaching Improvement' International Journal of Engineering Sciences & ResearchTechnology 2(11)pp3195-98

[26] Soni Abhishek(2014) ' Application of TQM in Higher education focused on improvement of technical institute via QFD' International J. of Engg. Research & Indu. Appls. (IJERIA). Vol.7, No. I (February 2014), pp 123-136

[27] Somadatta B. Karanjekar, Ramesh R. Lakhe, Vishwas S. DeshpandeReview ArticleQFD Applications in Education: A Literature Review International Journal of Basic And Advanced Research, 2013; 2(6); 124-132

[28] Soni Abhishek(2014) ' Quality Improvement of Technical Institute by using Quality Circles', National journal of excel education 1(2) pp04-06.