Enhancing Quality of Technical Education by Quality Function Deployment (QFD)

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Abstract

The aim of this paper is to identify and analyze different attributes which will help in improving quality of education in technical institute. This project is carried out in one of the recognized technical institutes in India. The work is divided in four phases. In first phase a survey is conducted for the students by circulating a questionnaire in which they were asked to rate different attributes on the scale of ten. After this similar survey is conducted for the faculty members. The data obtained from this survey is analyzed using various quality tools in the second phase. Pareto chart is used to prioritize the important factors. In the third phase of the project a quality house is constructed using the ratings given by students and faculties. For every attribute weighing factors are calculated and critical attributes are identified. Using this quality house an action plan is made to improve the quality. The final phase of the project is SWOT analysis of the institute. Various suggestions are given for improving the quality of education based on the identified opportunities and threats.

Keywords
Technical Education, Quality Function Deployment, Quality Tools.

1. Introduction

The main aim of a technical institution is to satisfy students on one hand by imparting quality education and industries on other hand by providing them good and capable workforce. A technical institute can be visualized as an organization which tries to fulfil demands of both internal customer (student) as well as external customer (industries). The internal customers are processed by the faculty members in the Technical Institute so as to fulfil demands of market i.e. external customers (Industries). Changing

requirements of both the customers (i.e. students as well as industries) call for the need for assessment of practical knowledge imparted by the institute, thus quality parameter study for technical institutions has become an essential task in present scenario.

The quality of technical institute depends on many parameters from students perspective like – the conditions of infrastructure and laboratory, effectiveness of teaching-learning process, appropriate design of curriculum, industrial exposure to students, library facility, research guidance etc. and that for the professor might be its ability to impart students with high intelligence and commitment to learning while for the government or industries, a high quality system is one that produces trained and capable scientists, engineers, and architects, doctors etc. to be required for serving society.

The present work gives a way, so as to satisfy the demands of industries along with students and to improve the quality by a 'concrete Action Plan'. After analysis of data, basic primary tool used for quality study is QFD (Quality Function Deployment) which helps in converting demand of customers (i.e. students) into action. It helps in understanding unspoken needs of customers (students) which are desperately needed to be fulfilled by the institute.

2. Objectives

Objectives of collecting the data from students and faculty members and analyzing it are –

(1) Understanding in which fields/areas the technical institute is satisfactory from students' (customers') and faculty members' perspectives and strengthening those areas.
(2) Understanding in which fields/areas the technical institute is unsatisfactory from students' (customers') and faculty members' perspectives and finding out reasons for it.
(3) Obtaining the priorities of customers (i.e. students) in regards to different parameters of quality of technical education.
(4) Finding out gap in the correlated quality parameters from students' as well as faculty members' perspective.
(5) Developing a line of action in the fields where there is scope of improvement from the results obtained from a quality tool.

3. Methodology

The steps followed for collecting the data and its subsequent analysis and interpretation is mentioned below –

3.1 Identification of Quality Attributes

To find out the scope of improvement in the technical institute, first step was identification of the parameters which attribute the Quality. Several parameters were identified and correlated parameters were grouped together. The Quality parameters for students and faculty were distinguished clearly.

3.2 Development of Questionnaires for Students (Customers for Institute) and Faculty members

Two questionnaires were prepared separately, one for the students and other for the faculty based on the quality attributes identified.

(a) Students' Questionnaire:
This questionnaire consisted of twelve major students' needs which comprised of sub-questions in them. The attributes in this questionnaire included teaching - learning process, infrastructure facilities, lab and library facilities, examinations and evaluation scheme, design of curriculum, industrial exposure, student-teacher relationship, and placements.

(b) Faculty Members' Questionnaire:
The attributes in this questionnaire included infrastructure, research facilities, schedules and brakes, career advancement opportunities, support from heads and deans, amount of non-technical work assigned etc.

3.3 Data Collection through Questionnaires

The questionnaires for students were distributed among the students of Mechanical Department of a well-known and recognized technical institute in India and 80 students from all four years of engineering gave their choices. Students were told to rate the needs as per the degree of importance from 1 to 10. They were also told to give priorities from 1 to 12 for the twelve identified quality attributes.

Similarly, the questionnaires for faculty members were also distributed and a total of 20 questionnaires were found to be complete and valid for analysis. They were also asked to rate the ten parameters of quality as per the degree of importance from 1 to 10. They were also told to give priorities from 1 to 10 for the ten identified quality attributes.

3.4 Analysis of Data

The data obtained from students and faculty was analyzed by using Bar Graphs and Pareto Chart. Gap analysis for the correlated attributes of quality was studied separately for quality attributes of faculty and students using Pie Diagrams.

3.5 Use of Tool – QFD for the data obtained

Quality Function Deployment tool was used further to get results regarding priorities and weighted scores of attributes of Quality of technical institute from Whats and Hows (Needs of Students' and Technical Descriptors – i.e. Voice of faculty) matrix.

4 Data Collection(Sampling) and Interpretation

4.1 Data collection Technique:

There are different methods like in-depth interviews, phone interview, online forms etc. which can be either direct method or an indirect method which are generally used to collect the data from stake holders of institute (students and faculty). For the current work the data is collected by circulating questionnaire in students and faculty. The students and faculty were asked to rate different attributes on the scale of ten. A sample of data collected from the students is shown below:

Student number ---------->	1	2	3	4	5	6
Attribute						
I						
I						
V						
Teaching-Learning Process:						
(a) Effectiveness of the Teaching-Learning Process –	1	3	7	2	7	6
(b) Depth of the content covered –	1	2	7	2	7	5
(c) Appropriate Utilization of Time –	7	1	8	2	3	6
(d) Proper way of presentation (i.e. Black-Board, Power-Point, Audio-Video) –	8	1	7	2	7	8
(e) Regular Feed-Backs (two-way communication) and Implementation of Feedback –	5	2	7	2	6	4
(f) Mathematical orientation and Application Based Teaching –	3	1	6	3	5	5
(g) Care taken for Participation of Students in process –	2	1	7	2	4	5
(h) Teaching-Learning Atmosphere (Generation of Interest out of Teaching-Learning Process)-	5	1	6	2	7	6
(i) Scheduling of Theory Classes(After Practical Hours) –	6	2	7	1	8	8
Infrastructure Facilities related to Teaching-Learning Process:						
(a) Sufficient Size of Class-rooms –	10	2	9	1	5	8
(b) Lighting and Ventilation –	5	2	7	2	7	7
(c) Projector Facility –	9	1	7	1	8	8
(d) Charger and LAN Ports –	1	1	7	2	9	8
(e) Xerox facility –	2	1	6	1	6	3

Fig 1. Sample Data entry in Excel after collection of students' questionnaire

4.2 Data Interpretation by using Bar charts:

(A) Data of Students:

The Entry of the data collected from Students Questionnaire is made in Excel. Then the total scores obtained to every Quality parameter is calculated out of maximum possible. Thus, the percentage scores are obtained for every Quality attribute of student. A gap is calculated in % from the percentage obtained. More gap indicates more scope for improvement. The Result table of scores for Students' Questionnaire is shown below –

Attribute	Obtained	out of	%	gap
Teaching-Learning Process	4123	5850	70.48%	29.52%
Infrastructure Facilities related to Teaching-Learning Process	2066	3250	63.57%	36.43%
Laboratory Facilities	2972	4550	65.32%	34.68%
Library Facilities	2293	4550	50.40%	49.60%
Examination and Evaluation Scheme	3092	5850	52.85%	47.15%
Placement	1527	1950	78.31%	21.69%
Industrial Exposure	1481	3250	45.57%	54.43%
Design of Curriculum	1198	2600	46.08%	53.92%
Student - Teacher Relationship	2051	3900	52.59%	47.41%
Suggestion Portal/System of Feedback	869	1950	44.56%	55.44%
Total	22955	**45500**		

Table 1. Result table of scores for Quality Attributes of Students' Questionnaire

Following bar chart shows the ratings given by students to each attribute in questionnaire from the result table. Graph is drawn by converting the ratings given into percentage contribution. The Placement attribute is rated with highest priority by the students.

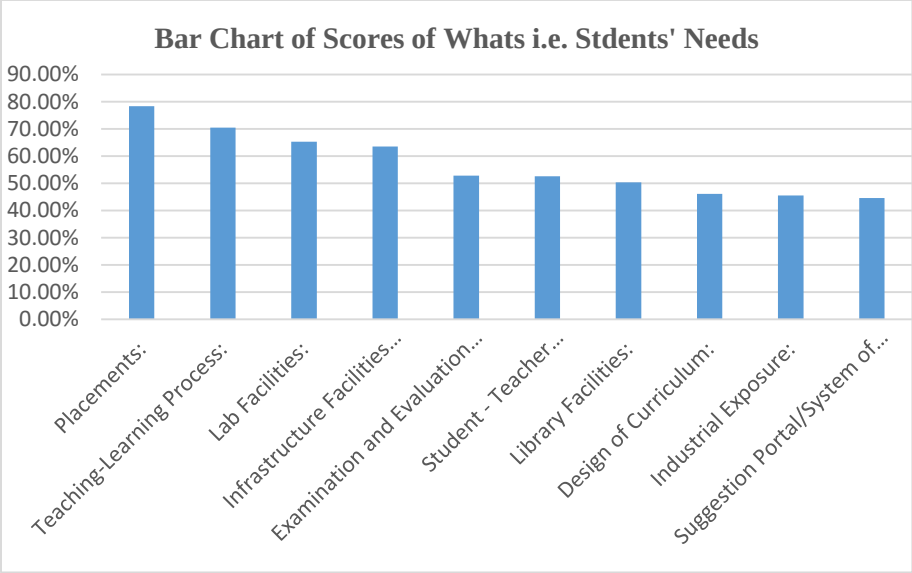

Fig. 2 - Bar Chart of Scores of Whats i.e. Stdents' Needs

(B) Data of Faculty members –

Similarly, the data collected from Teachers' Questionnaire is made in Excel. Then the total scores obtained to every Quality parameter is calculated out of maximum possible and % obtained score and Gap is calculated in this case also.

Attributes	Obtained	Out of	%	gap
Infrastructure	240	480	50%	50%
Classrooms	270	480	56%	44%
Lab and Research Facilities	659	960	69%	31%
Amount of Non-Technical Work Assigned	140	480	29%	71%
Teaching Load Distribution	164	240	68%	32%
Schedule and Breaks	217	360	60%	40%
Students' Evaluation	165	240	69%	31%
Class Size	129	240	54%	46%
Responses of Students (Rapo generation with student)	364	720	51%	49%
Support from Heads, Deans and Colleagues	541	840	64%	36%
Supporting Staff Availability	114	360	32%	68%
Opportunity for career advancement	512	830	62%	38%
Total	3515	6230		

Table 2. Result table of scores for Quality Attributes of Faculty members' Questionnaire

Following bar chart shows the ratings given by faculty to each attribute in questionnaire from the result table. Graph is drawn by converting the ratings given into percentage contribution. The Lab and Research Facilities attribute is rated with highest priority by the faculty.

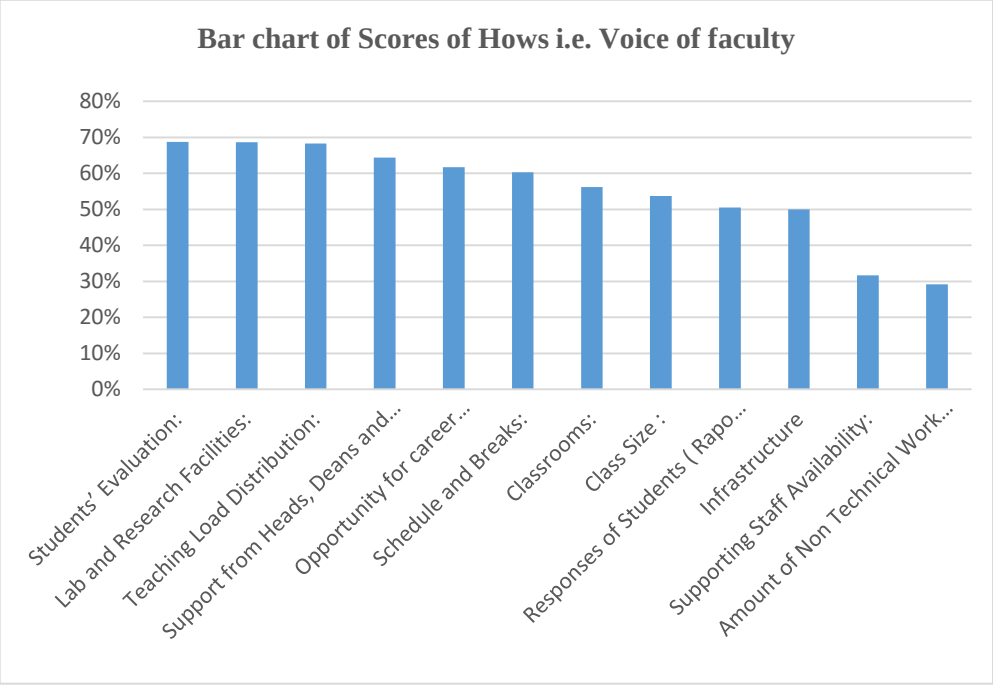

Fig. 3 - Bar Chart of Scores of hows i.e. Faculty members' Voice

4.3 Gap Analysis –

(A) Gap analysis of Correlated Quality Attributes of Students:

To simplify the analysis of data, Quality attributes are divided into four main topics namely academics, co-curricular, extra -curricular and extension services for students. A correlation (affinity) of parameters is identified in the following manner –

(a) Academics – Teaching-Learning Process, Examination and Evaluation Scheme, Library Facilities, Lab Facilities, Design of Curriculum.
(b) Co-curricular – Industrial Exposure, Placements, Student - Teacher Relationship.
(c) Extra-curricular – House-Keeping Activity (Cleanliness) and Safety Observed, Infrastructure Facilities related to Teaching-Learning Process
(d) Extension Services – Moral boosting/Motivation, feedback system.

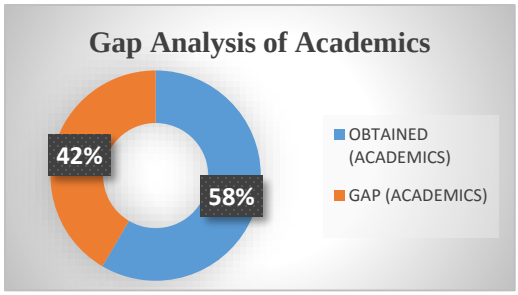

Fig 4 (a) Gap Diagram for Academics

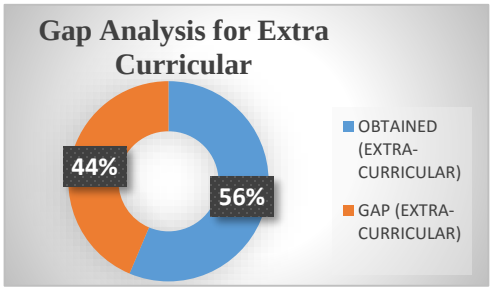

Fig 4 (b) Gap Diagram for Extra-curricular

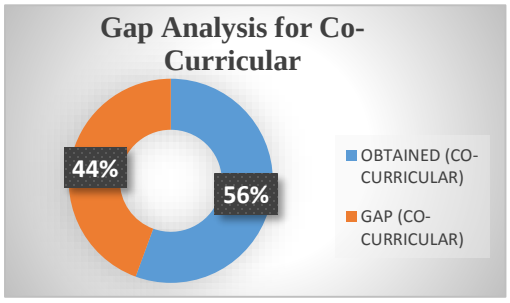

Fig 4 (c) Gap Diagram for Co-Curricular

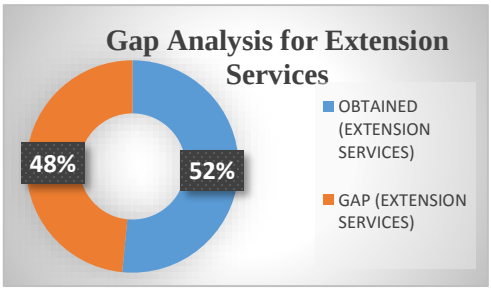

Fig 4 (d) Gap Diagram for Extension services

From the Gap analysis of the correlated quality attributes from Students perspective, it is seen that there is ample scope of improvement in all four areas in the institute selected. There are few sub-attributes in which students are satisfied but some sub-attributes of same main attribute in which they are less satisfied. Ex.: In Academic attribute, scores to Teaching-Learning Process (70.48%), Lab Facilities (65.32 %) have got good score while Examination and Evaluation Scheme (52.85%), Library Facilities (50.45 %), Design of Curriculum (46.08 %) have got low score. Cumulative effect of which is the gap of 42%. The main aim for improving Quality is to reduce this gap in all four sectors as per their weightage obtained from data of priorities. It can also be concluded that the students are less satisfied with the extension services since maximum gap is found for this attribute.

(B) Gap analysis of Correlated Quality Attributes of Faculty members:

To analyze the gap of attributes, these attributes are clubbed into four groups which are infrastructure, teaching-learning process, support, planning and scheduling. The attributes are assigned to each group as follows:
1. Infrastructure: Infrastructure, Lab and Research facility, Classroom
2. Teaching and Learning Process: Students evaluation, class size, responses of students
3. Planning and scheduling: Amount of non-technical work assigned, teaching load distribution, scheduling and breaks,
4.Support: Support from heads, deans, colleagues, supporting staff availability, opportunity for career advancement.

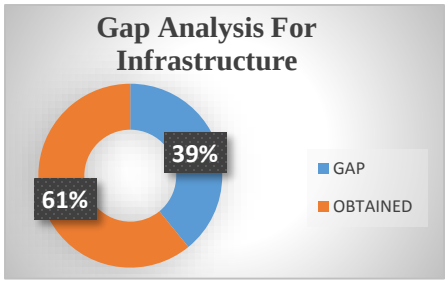

Fig 5 (a) Gap Diagram for Infrastructure

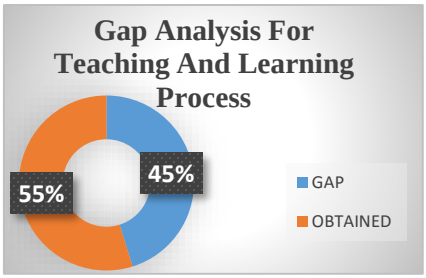

Fig 5 (b) Gap Diagram for Teaching and Learning Process

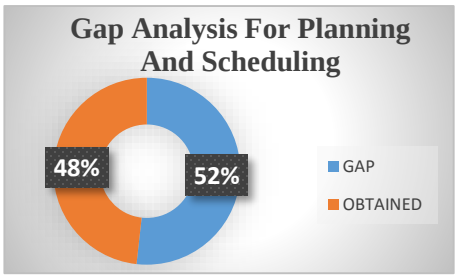

Fig 5 (c) Gap Diagram for Planning and Scheduling

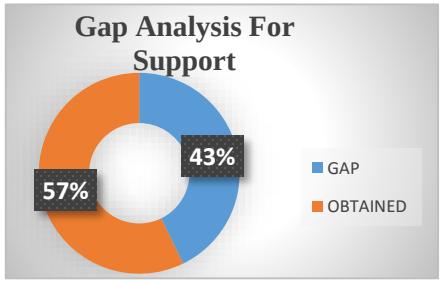

Fig 5 (d) Gap Diagram for Support

From the gap analysis of co-related attributes, it can be concluded that infrastructure facility has the highest improvement potential due to its largest gap. After infrastructure, support has the highest gap followed by teaching-learning process and planning/scheduling. To improve the quality of education and to increase faculty satisfaction, these attributes and their sub-attributes must be improved in order of their gaps.

4.4 Pareto Charts –

To prioritize the data obtained from questionnaire of students and faculty for finding out most important change which is to be made for enhancing quality of institution.

(A) Students' Priority:

To prioritize the data obtained from students, the most important Quality attribute i.e. Placements is analyzed further. Placement consists of following sub-attributes:

(a) Pre-placement Training (for Aptitude Tests, Group discussions, Interviews etc.)
(b) Awareness about the position, job details in the company
(c) Satisfactory Package

To find out which one is most dominant among these three sub-attributes, a Pareto chart is drawn. Pre-placement training has received maximum score (36.3%) thus will have first priority among all (Fig. 6(a)).

(B) Faculty members' Priority:

To prioritize the data obtained from teachers, the most important Quality attribute i.e. Amount of non-technical work assigned is analyzed further. Non-technical work assigned to faculty consists of following sub-attributes:

(a) Other responsibilities (like gymkhana, gathering etc.)
(b) Club staff advisor
(c) MIS Registration of students
(d) New college admission

To find out which one is most dominant among these four sub-attributes, a Pareto chart is drawn. Other responsibilities sub-attribute has received maximum score (26.8%) thus will have first priority among all (Fig. 6(b)).

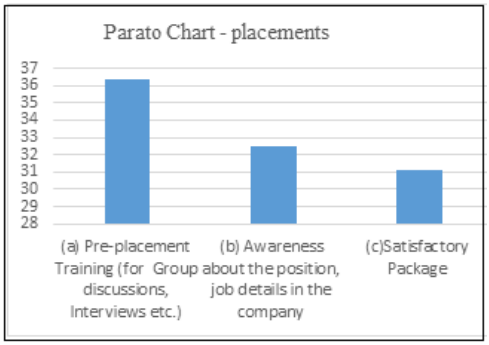

Fig 6 (a) Pareto Chart for Placements – students' voice

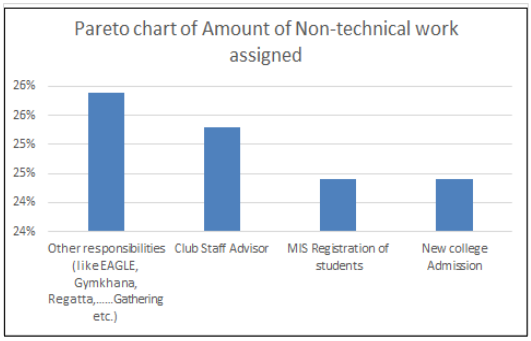

Fig 6 (b) Pareto Chart for Other responsibilities – Teachers' voice

5. Mapping of WHATs against HOWs through QFD:

5.1 QFD and Quality House:

Quality function deployment (QFD) is a Quality tool which helps to transform customer needs (the voice of the customer i.e. students for current analysis) into engineering characteristics for a product or service (Education for current analysis). It helps create operational definitions of the requirements. It prioritizes each product or service characteristic while simultaneously setting development targets for the product or service. There are different techniques and tools based on Quality Function Deployment. The House of Quality is one such technique which is used in this project to prioritize the attributes.

House of Quality is a diagram, resembling a house, used for defining the relationship between customer desires and the firm/product capabilities. It is a part of the Quality Function Deployment (QFD) and it utilizes a planning matrix to relate what the customer wants to how a firm is going to meet those wants. It looks like a house with a "correlation matrix" as its roof, customer wants versus product features as the main part, competitor evaluation as the porch etc. It is based on "the belief that products should be designed to reflect customers' desires and tastes".

5.2 House of Quality for Technical Institute under consideration:

Using QFD Software, quality house is constructed (Fig. 7) taking customer requirement as students' voice (WHATs) & technical descriptor as Faculty members' voice (HOWs).10 important attributes are identified from students' questionnaire (out of 12) & 10 attributes are identified from teachers' questionnaire and are included in customer requirement matrix & correlation matrix is filled by assigning the weight-age according to the relation between the attributes.

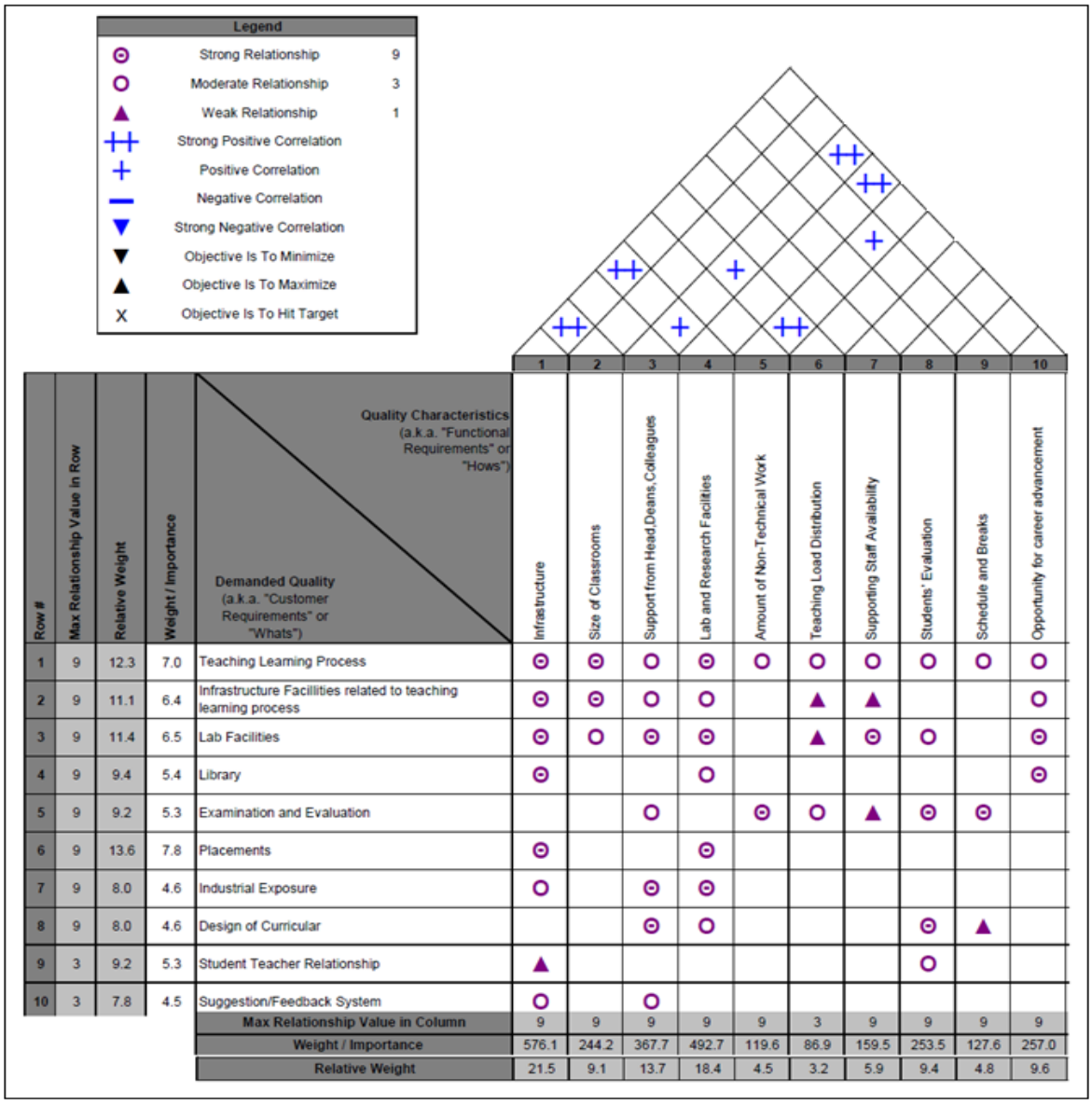

Fig.7 Quality House for Analysis Quality of Technical Education

5.3 Results Obtained from Quality House:

(a) For Technical Descriptors:
Maximum Relative weight = 21.5 (For Infrastructure)
Minimum Relative weight = 3.2 (For Teaching Load Distribution)

(b) For Customers Demands:
Maximum Relative weight = 7.8 (For Placements)
Minimum Relative weight = 4.5 (For Suggestion and Feed-back system)

The results indicate following points -

(1) Placement has highest Priority as far as Students' demand is concern, thus institution should try its best to see maximum Customers(Students) get placed in good companies and institute may arrange for skill improvement programs for increasing the satisfaction of students.

(2) Infrastructure has highest Priority from Teachers' point of view and facilities like chord-less mikes, White board, Projectors etc. should be provided along with maintenance.

Highest weight-age is given to placements by students and to infrastructure by teachers. Placement strongly correlates with infrastructure, Laboratory and research facility. Also infrastructure has strong relation with teaching-learning process, laboratory facility, and library facility.

6. Discussion:

Following table is used to find out nature of attribute using value of relative weight and gap value obtained in appropriate tables.

	High Gap	Low Gap
High Relative Weight	Very Important & Very Urgent	Very Important & Less Urgent
Low Relative Weight	Less Important & Very Urgent	Less Important & Less Urgent

6.1 Line of action:

What to improve	Who can improve	How to improve	Severity of issue
Infrastructure	Administration	• Creating Spacious rooms • Making Furniture available • Ventilation and air conditioning • Lighting and speaker arrangements	Very Important but less urgent
Placements	Administration	• Training students • Increasing number of companies visiting for recruitment • Increasing industry exposure of students	Very Important but less urgent
Teaching learning process	Teachers, Students	• Creating interest in students • Using different styles of teaching like videos or demos of actual/ models • Increasing participation of students	Very Important and Very urgent
Extension Services	Administration	• Reducing the burden of extension services • Reducing extracurricular activities	Less Important but Very urgent
Planning and scheduling	Administration	• Planning lectures and lab timing conveniently • Lectures in fresh hours then labs	Less Important but Very urgent

		• Equal distribution of lectures in week	
Student's evaluation	Teachers	• Freedom for evaluation of student • Freedom of paper setting and examination style	Less Important and Less urgent
Laboratories and research facilities	Administration	• Making world class research facilities available • Making laboratories available for 24 hours	Very Important and Very urgent

6.2 SWOT Analysis:

STRENGHT	WEAKNESS
1.Dedicated Enthusiastic Staff 2.Hardworking, Talented and Multi-Dimensional Students 3.Technical, Non-Technical Clubs Placement 4.Teaching learning process	1.Less Research 2.Less Funding 3.Inadequate Infrastructure 4.Inadequate Laboratory 5.Examination and evaluation scheme 6.Library facility 7.Design of curriculum
OPPORTUNITIES	**THREATS**
1.Being Top institute 2.Well qualified staff 3.Good industry Relation 4.Strategic alliances and partnerships with international institutions for offering more professional courses.	1.Politicizing education 2.Growing competition 3.Excessive internet use by students

6.3 Conclusions

1 From Gap Analysis of the correlated attributes for students it can be observed that there is the largest gap in Academics. Whereas from gap analysis for teacher, it can be observed that there is more scope for improvement for planning and scheduling.

2 Bar chart of student highlights importance of placement attribute (80%). Less priority is given to design of curriculum.

3 From Teachers Pareto chart it can be concluded that teachers have given high priority to infrastructure. Teachers have given 7^{th} priority to amount of non-technical work assigned which reduces the severity of this attribute.

Acknowledgement

We express our deep sense of gratitude to all the faculty members and students who gave their valuable time for completion of the survey. The completion of this work could not have been possible without valuable guidance, keen interest and encouragement of Dr. M. P. Khond. We thank Dr. Ajay Bhattu and Mr. Mayur Patil for their valuable feedback which helped improve the quality of this paper.

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