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### **IMPLEMENTATION OF QUALITY FUNCTION DEPLOYMENT UTILIZING ANALYTICAL HIERARCHY PROCESS IN A TECHNICAL INSTITUTE**

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#### **ABSTRACT**

Quality Function Deployment (QFD) is a systematic approach to integrate customer needs and requirements into every aspect of the design and delivery of products and services to the customers. A successful product is one, which is design and developed as per the requirements and needs. Therefore getting the customer's needs and requirements from a product or service is very crucial.

This study uses management tool QFD for quality improvement and benchmarking in a technical institute by identifying the needs and requirement of customer (students of institute) with the aid of questionnaire. This study is an attempt to review and encourage the application of QFD for planning and improvement of quality by achieving the customer (students) needs.

The ultimate element of Quality Function Deployment (QFD) is HOQ suggest technical parameter (How's) for each Voice of Customer (What's) and the importance rating for each of them, which can be used for improving the quality of engineering education in the college under study. This study will prove to be beneficial for various technical institutes as it highlighted the major concerned areas of quality improvements in the technical education.

*Keywords: Quality Function Deployment (QFD), Analytical Hierarchy Process (AHP), Technical Institute, House of Quality (HOQ), Technical Parameters, Customer Requirements.*

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#### **I. INTRODUCTION**

In this competitive era, satisfaction of customer is become the most important factor for success of any firm either it is delivering product or providing any service. Quality is the most influencing factor of customer's satisfaction. Now a day, Quality is the major competitive factor throughout the world and this competition increases the demand for the quality products and services. In this customer demanding market, customer has number of choices of a particular product. So to become a first choice of the customer every firm have to meet the quality aspects and requirements demanded by the customers. To achieve these quality demands various techniques of total quality management such as Six Sigma, JIT, Kaizen model, Kanban model etc has been adopted by almost of the firms.

When we are considering quality in any product and service, this factor is equally important in education sector as well. As education is the best defense of any nation Quality education is very important in any nation for development and survival. Quality Function Deployment (QFD) is one of the technique of Total Quality Management (TQM). One of the best way to achieve the expectations of the customer is to get aware of the needs and requirements of the customer before the delivery of the product or service. QFD is the technique, in which the requirements and needs of the customer are to be identified before designing of the product or service.

Quality Function Deployment (QFD) is the proactive product development rather than reactive product development. This proactive development results in fewer and earlier changes in design, reduces development time, less start-up problems, low start-up cost, few field problem and more satisfaction of the customer.

#### **II. LITERATURE REVIEW**

##### ***Quality in Education***

According to the Marshall, (1998), "Quality in higher education is a complex concept that has eluded clear definition." Directly or indirectly, the quality in education affects many of its stakeholders such as students, teacher, employers, non-teaching staff, government etc. All the mentioned stakeholders have a different view of quality in

education. Although, education sector is the base of development of any nation, it is lacking in applying the techniques to improve the quality of education.

The difficulty 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, Vikram Singh et al. (2008). According to Sahney et al. (2002), the definition of TQM in Education is as follows:

“Total Quality Management in education is multifaceted. 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 learning and teaching activity; and quality of outputs in the form of the enlightened students that move out of the system”.

### ***Quality Function Deployment in Education***

Quality Function Deployment (QFD) can be defined as a method of transferring customer needs and requirements into technical specifications for new product and service development before actual production. The founder of QFD, Akao, defined QFD as “A method for developing design quality aimed at satisfying the consumer and then translating the consumer’s demand into design targets and major quality assurance points to be used throughout the production phase” Akao (1990). Application of QFD in education may prove to be beneficial to improve quality of higher education. Identifying Customer requirements, evaluating priorities of the requirements, identifying technical characteristics are the main steps in a QFD analysis, Vikram Singh et al (2008). Clayton (1993) used QFD to provide productive quality learning. Jaraiedi and Ritz (1994) applied QFD to improve advising and teaching processes at West Virginia University.

### ***Need Of Quality Aspect In Technical Education***

TQM is important aspect in Technical Institutions for the some of the following reasons:

1. To be cost effective as it eliminate redesign
2. To be always remain in the market
3. To be able of keeping customer confidence.
4. To improve satisfaction of the customer and to develop confidence of customer.
5. To provide platform to use the creativity of faculty and students for development of the institution.
6. To provide job satisfaction to all employees
7. To be a part of healthy competition
8. To provide benchmark to other institutions
9. To reduces the waste of resources at all levels.

### ***Benefits of QFD***

Some of the benefits of implementation of QFD are discuss below:

- Quality Function Development reduces development time & cost
- It reduces in design changes
- Implementation of QFD reduce Start-up problems
- It decreases design and manufacturing costs
- Improvement in quality is the offering of QFD
- Ultimately QFD provides the customer satisfaction
- Toyota strongly influenced adoption of QFD in North America

Between 1977-1984 achieved a 61% reduction in product development cost, a 33% reduction in product development cycle, and virtual elimination of rust related warranty problems.

## **III. METHODOLOGY**

First of all Quality Function Deployment (QFD) is utilized. Then the basic Analytic Hierarchy Process (AHP) is use based on the QFD and the data acquired. All the steps of basic QFD are performed and then the prioritization of the requirements is done with the help of AHP. At the end, House of Quality (HOQ) is developed showing the importance of each technical parameter in achieving the customers (students) requirements.

### **Steps of Quality Function Deployment (QFD)**

**I: Identification of Customers Requirements/Needs:**

In our study, the customers are the students and faculty of the institute. The requirements/needs of the customers are identified as voice of customer (VOC) and determined through the various literatures, guidelines of AICTE, brainstorming and survey.

**II: Development of Questionnaire and Collection of Responses:**

A questionnaire is developed on the basis of these requirements/needs and responses are collected from the customers. The complete questionnaire along with total responses is shown in the table below.

**III: Identification of Technical Parameters:**

To address the needs and requirements of the customers some technical parameters are to be identified. The following are the technical requirements related at least to one of the requirements of customers.

1)Flexibility 2)Faculty Development Programme (FDP) 3)Competent with IT 4)Course Development 5)Industrial Exposure 6)Campus Recruitment Training (CRT) 7)Special GD and PI classes 8)Timely Feedback 9)Qualification 10)E-services.

**IV: Sampling Plan:**

The total strength of the institute is 1375 students of one engineering college, from first year to final year of all the branches of engineering of the college e.g. mechanical, civil, electronics & communication, computer science & engineering and information technology. Sampling unit was „the student/faculty“ and method used was simple random. Calculation of minimum sample size was done as per formula below: S Shajahan (21).

$$n = p \% \times q \% \times [z/e \%]^2 .$$

Where **n**- minimum sample size, **p**- Proportion of abnormal response (specified category), **q**- Proportion of normal response., **z** -Value corresponding to level of confidence 95% = 1.96, **e**- Margin of error 5%,

$$n = 20 \times 80 \times [1.96/5]^2 = 245,$$

Actual Samples collected- **325** (students) and **34** (Faculty)

**V: Prioritization of Customer's Requirements/Needs Using Analytical Hierarchy Process (AHP):**

First of all collection of responses against the questionnaire developed is done. In total 325 responses of students and 34 responses of faculties are collected, out of which 309 student's responses and 32 faculty's responses are found to be valid. After performing the basic method of Analytical Hierarchy Process (AHP), the two matrices are obtained as shown in the table.....

**VI: Relationship Between VOC and Technical Parameters:**

The relationship between voice of customer (VOC) and technical parameters (TP) are given in the table below. Relation among the VOC and technical parameter are related with a digit as 9, 3, 1, and 0. A digit 9 indicates a strong relationship among the VOC and TP, while a digit 0 indicates that no relation among the two. 3 and 1 is for moderate and weak relationship respectively among VOC and TP.

**VII: Correlation between Technical Parameters:**

In this step, the correlation between the technical parameters is to be determined. In order to achieve the expectation of the customer some technical are to be identify. In this way one technical parameter may have positive relation with other parameters in this condition both of these contributed toward the achievement of VOC. But some parameters have negative relationship with other, so these two parameters contradict each other. As all the technical parameters are somehow important to achieve the expectations of the customer, so a trade-off has to be done between the two parameters having negative relationship among themselves.

In the study the relation between the technical parameters are show at the roof of the House ofQuality (HOQ), where O= positive relation and X= negative relation.

**VIII: Development of House of Quality (HOQ):**

In this step all the data collected in all the above steps are to be placed at appropriate placed in the House of Quality (HOQ). This is the ultimate table of the Quality Function Deployment (QFD).The HOQ of the study is shown in the table.

#### IV. DATA COLLECTION AND ANALYSIS

1. A Questionnaire:

*Table 1. A Questionnaire with Total Responses. Student-Normal digit, Faculty-Bold*

S . N o	QUALITY DIMENSIONs	CHARACTERISTICS	I	II	III	IV
1	TEACHING & LEARNING PROCESS	i)Technological resources should be used by the professor in the discipline ii)Accessibility to the professor out of the classroom iii)Apprenticeship programme should be introduce in the curriculum from the 2 <sup>nd</sup> year onwards iv) English as a subject should be introduce in the course.	<b>128</b> 1101 <b>115</b>	1360  1321 <b>152</b>		
2	TRAINING & PLACEMENT	i)Career guidance and placement information must be communicate to the student at from the 1 <sup>st</sup> year onwards ii)Training and personality development classes should be arrange on regular basis			173  1650 <b>181</b>	1742
3	RESPONSIVENESS	i)Action on feedback and suggestion of student must be communicate in the certain period of time. ii) Administration office must be responsive and efficient in providing services.		1374 <b>140</b> 1348 <b>158</b>		
4	INFRASTRUCTURE	i)Laboratories: -Latest and proper instruments are required ii)Workshop: - Latest and more number of machines are required				1906 <b>213</b> 1768 <b>192</b>
5	FACILITIES	i)Internet access (secured Wi-Fi) should be provide throughout the college campus. ii)Library:- More number of books and of different authors are required.	<b>133</b>		1624	1873 <b>206</b>

Where,

I- Not At All Important, II- Moderately Important, III- Important, IV- Very Important

2. Student's Responses To Voice of Customer (VOC)

**Table 2. Student's Responses to VOC**

Voice of Customer(VOC)	i)Technological Resources	ii)Accessibility To Professor	iii)Apprenticeship Programme	iv)English as a Subject	v)Career Guidance &	vi)Training and P.D	vii)Action on Feedback	viii)Responsiveness of	ix)Updated laboratories	x)Latest and more no. of	xi)Internet Access	xii)Updated Library
Total Points:	1360	1101	1321	1223	1742	1650	1374	1348	1906	1768	1624	1873
Ranking:	3	1	3	1	9	5	3	3	9	9	5	9

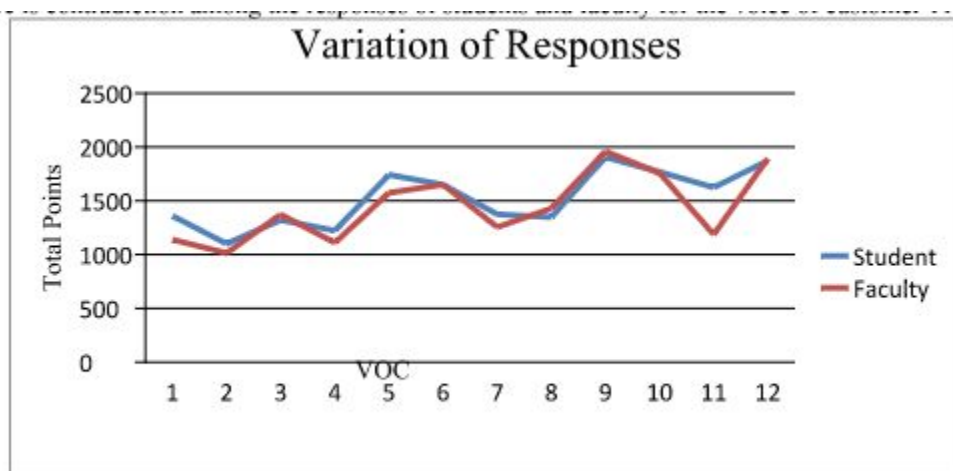
### 3. Faculty's Responses To Voice of Customer (VOC)

**Table 3 Faculty's Responses to VOC**

Voice of Customer(VOC)	i)Technological	ii)Accessibility To	iii)Apprenticeship	iv)English as a Subject	v)Career Guidance &	vi)Training and P.D	vii)Action on Feedback	viii)Responsiveness of	ix)Updated laboratories	x)Latest and more no. of	xi)Internet Access	xii)Updated Library
Total Points:	128	115	152	125	173	181	140	158	213	192	133	206
Ranking:	1	1	3	1	5	5	3	3	9	9	1	9

### 4. Trend of Students and Faculty Responses

The following graph in figure 4.3 shows the comparison of responses of students and faculty responses for each voice of customer (VOC). From the graph, it is clearly seen that according to both students and faculties the voice of customer 9,10 and 12 are most important and voice of customer 2 and 4 are of less importance of all, while there is contradiction among the responses of students and faculty for the voice of customer 11.



**Figure 1. Comparison of VOC**

### 5. Prioritization of VOC for the Student's Responses

**Table 4. Priority Matrix (Student's Responses)**

VOC → ↓	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
I	1	3	1	3	1/5	1/3	1	1	1/5	1/5	1/3	1/5
II	1/3	1	1/3	1	1/9	1/5	1/3	1/3	1/9	1/9	1/5	1/9
III	1	3	1	3	1/5	1/3	1	1	1/5	1/5	1/3	1/5
IV	1/3	1	1/3	1	1/9	1/5	1/3	1/3	1/9	1/9	1/5	1/9
V	5	9	5	9	1	3	5	5	1	1	3	1
VI	3	5	3	5	1/3	1	3	3	1/3	1/3	1	1/3
VII	1	3	1	3	1/5	1/3	1	1	1/5	1/5	1/3	1/5
VIII	1	3	1	3	1/5	1/3	1	1	1/5	1/5	1/3	1/5
IX	5	9	5	9	1	3	5	5	1	1	3	1
X	5	9	5	9	1	3	5	5	1	1	3	1
XI	3	5	3	5	1/3	1	3	3	1/3	1/3	1	1/3
XII	5	9	5	9	1	3	5	5	1	1	3	1
Σ=	30.66	60	30.66	60	5.68	15.72	30.66	30.66	5.68	5.68	15.72	5.68

6. Prioritization of VOC for the Faculty's Responses

**Table 5. Priority Matrix (Faculty's Responses)\_**

VOC → ↓	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
I	1	1	1/3	1	1/5	1/5	1/3	1/3	1/9	1/9	1	1/9
II	1	1	1/3	1	1/5	1/5	1/3	1/3	1/9	1/9	1	1/9
III	3	3	1	3	1/3	1/3	1	1	1/5	1/5	3	1/5
IV	1	1	1/3	1	1/5	1/5	1/3	1/3	1/9	1/9	1	1/9
V	5	5	3	5	1	1	3	3	1/3	1/3	5	1/3
VI	5	5	3	5	1	1	3	3	1/3	1/3	5	1/3
VII	3	3	1	3	1/3	1/3	1	1	1/5	1/5	3	1/5
VIII	3	3	1	3	1/3	1/3	1	1	1/5	1/5	3	1/5
IX	9	9	5	9	3	3	5	5	1	1	9	1
X	9	9	5	9	3	3	5	5	1	1	9	1
XI	1	1	1/3	1	1/5	1/5	1/3	1/3	1/9	1/9	1	9
XII	9	9	5	9	3	3	5	5	1	1	9	1
Σ=	50	50	25.32	50	12.79	12.79	25.32	25.32	4.7	4.7	50	4.7

7. Evaluation of Consistency of Student's Responses

a) Principle Eigen Value ( $\lambda_{max}$ ):

$$=30.66(0.0345)+60(0.0150)+30.66(0.0345)+60(0.0150)+5.68(0.1700)+15.72(0.077)+30.66(0.0345)+30.66(0.0345)+5.68(0.1700)+5.68(0.1700)+15.72(0.0770)+5.68(0.1700)$$

$$\lambda_{max} = 12.31$$

b) Consistency Index =

$$n - 1$$

$$C.I = 0.0281$$

c) Consistency Ratio =

$$C.R = 0.01767$$

i.e. 1.767% < 10%, this implies subjective evaluation is quiet **consistent**.  
Similarly prioritization of VOC is done as per the faculty responses and the

Consistency ratio = 1.543% is also well within the limit.

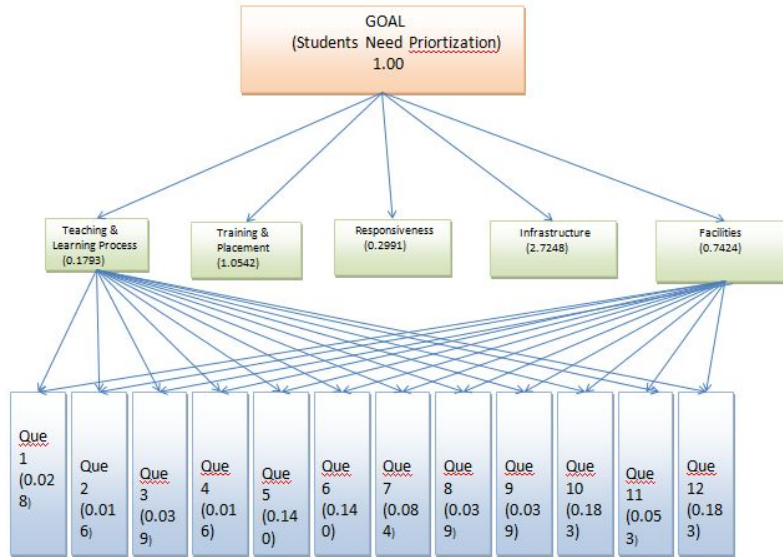
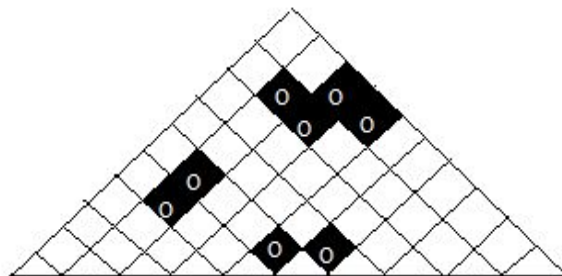


Figure 2. Analytical Hierarchy Process (AHP) (Only two relationships has been shown between criteria and sub criteria to avoid congestion)

8. Relationship Between VOC and Technical Parameters **Table 6. Relationship Matrix among VOC and TP.**

Technical Parameters (T.P) →	T.P 1	T.P 2	T.P 3	T.P 4	T.P 5	T.P 6	T.P 7	T.P 8	T.P 9	T.P 10
Voice of Customer ↓										
VOC 1	0	3	9	3	3	0	0	1	1	9
VOC 2	9	1	3	0	1	0	1	0	3	3
VOC 3	0	0	0	9	9	3	1	0	0	3
VOC 4	0	3	0	9	1	3	9	0	1	1
VOC 5	0	3	3	9	1	9	3	3	1	3
VOC 6	0	3	1	3	3	9	9	0	1	3
VOC 7	0	0	1	0	0	0	0	9	0	3
VOC 8	0	0	0	0	0	0	0	9	0	3
VOC 9	1	3	3	3	1	0	0	1	9	1
VOC 10	1	3	1	3	3	0	0	1	9	1
VOC 11	0	0	3	0	0	0	0	1	0	9
VOC 12	1	3	1	3	3	1	1	1	3	3

9. Structured House of Quality (HOQ)



Quality Dimensions	Characteristics	Importance Rating		Weighted Rating		Final Rating	Flexibility	FDP	Competent with IT	Course Developm	Industrial E	Campus Recruitme	Special	Timely	Qualificati	E-Services
		Faculty	Student	Faculty 40%	Student 60%											
<b>TEACHING &amp; LEARNING PROCESS</b>	i)Technological Resources	0.018	0.035	0.01	0.021	0.028	0	3	9	3	3	0	0	1	1	9
	ii)Accessibility To Professor	0.018	0.015	0.01	0.009	0.016	9	1	3	0	1	0	1	0	3	3
	iii)Apprenticeship Programme	0.045	0.035	0.02	0.021	0.039	0	0	0	9	9	3	1	0	0	3
	iv)English as Subject	0.018	0.015	0.01	0.009	0.016	0	3	0	9	1	3	9	0	1	1
<b>TRAINING AND PLACEMENT</b>	v)Career & Placement Information	0.094	0.170	0.04	0.102	0.140	0	3	3	9	1	9	3	3	1	3
	vi)Training and P.D Classes	0.094	0.077	0.04	0.046	0.084	0	3	1	3	3	9	9	0	1	3
<b>RESPONSIVENESS</b>	vii)Action on Feedback	0.045	0.035	0.02	0.021	0.039	0	0	1	0	0	0	0	9	0	3
	viii)Responsive Admin Office	0.045	0.035	0.02	0.021	0.039	0	0	0	0	0	0	0	9	0	3
<b>INFRASTRUCTURE</b>	ix)Updated labs	0.202	0.170	0.08	0.102	0.183	1	3	3	3	1	0	0	1	9	1
	x)Updated Workshop	0.202	0.170	0.08	0.102	0.183	1	3	1	3	3	0	0	1	9	1
<b>FACILITY</b>	xi)Internet Access	0.018	0.077	0.01	0.046	0.053	0	0	3	0	0	0	0	1	0	9
	xii)Updated Library	0.202	0.170	0.08	0.102	0.183	1	3	1	3	3	1	1	1	3	3
Weightage:																
Faculty-							28	99	77	165	86	95	62	70	16	10
Student-							42	148	115	248	128	142	93	105	25	14
Total:							69	247	192	417	214	236	15	15	41	23



Ranking:								10	4	7	2	6	5	9	8	1	3
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**Table 7. Structured House of Quality (HOQ)**

<p><b>Correlation Matrix</b> How's vs How's</p> <p>o positive x negative</p>	<p><b>Relationship Matrix</b> What's vs How's</p> <p>9 strong relation 3 moderate relation 1 weak relation 0 no relation</p>
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## V. RESULT AND DISCUSSION

In this study, we aimed to reveal students' expectations for a technical institute and improve the service quality of the institution. QFD method was used for the realization of these objectives. First, the student expectations were determined and importance values were obtained with the help of the developed questionnaire. Then expectations were converted into technical requirements, competitive analysis was done and house of quality has been created. House of quality is given in Table.

The Voice of Customer (VOC) has been identified explicitly as a result of structured analysis and prioritization of needs. Application of AHP and pair wise comparison provides good measure of consistency as CR were well within the limits, proving that the judgment ratings given by the students and the faculty were quite valid.

The study has highlighted the areas which need to be addressed on priority to attain a competitive advantage as well as the requirement of continuous assessment of the competitors and continuous improvement to delight the customers. The following needs of the students must be addressed on priority:

1. The laboratories of institute need to be occupied with latest and proper instruments. This question is ranked highest by both students as well as faculty in their responses.
2. Both the student and faculty also give high importance in their responses to the question related to workshop. So as per their requirements, latest and more number of machines are required in the institute.
3. As per customers responses to the question related to library of the institute, it gets highest rank as 9, it indicates that number of books should be increased and also the books should be of different author and publications are required.
4. According to the student responses, career guidance and placement information must be communicated to the students from the first year onwards. However, the faculty responses do not ranked it high.
5. The next priority should be given to the training and personality development classes. These classes should be arrange on regular basis. The responses of the customer ranked it second highest.
6. According to both the customers (students and faculties), accessibility to the professor out of the class room and English as a subject in the course is not important at all. The customer's responses give this question lowest ranking.
7. While the faculty responses do not give any importance to utilization of technological resources in the discipline, the student responses indicates it moderately important.
8. As per the final ranking of technical parameters in the House of Quality (HOQ), the qualification faculties and lab assistants is the parameter having highest impact on the voice of customer(VOC) to fulfill the needs/requirements of the customers.
9. Second parameter having the high impact on the VOC is course development, while the flexibility of the interaction with the professor has lowest impact on the voice of customers.
10. The institute should keep focus and regular monitoring is required of the findings of the study in order to satisfy the customers by achieving the expectations of the customers.

## VI. CONCLUSION

In this era, quality in education is become very important. One of the reasons of unemployment in India is surely the lack of skills in the graduates of the colleges. Job oriented skills is the basic requirement for the employment in any firm. These skills may be develop in the students by enhancing the quality in education. This paper tries to work for the improvement of quality by addressing the needs of the students of technical institute. This paper focuses the requirements/needs of students of the technical institute and finding out the technical parameters to achieve these requirements. The paper also prioritizes the requirements with the help of Analytical Hierarchy Process (AHP). At the end this paper shows the ranking of the technical parameters as per their impact towards fulfilling the voice of customer. The institute should achieve these voice of customer by giving priority to the technical parameters having high ranking. This further opens the scope of future research by having a survey in various institutions and university and finding out the actual importance rating/ranking and validating those results with the present one.

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