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A Framework for implementation of Total Quality Management in Engineering Education Institutes (EEIs)

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Abstract— In current scenario engineering education institutes (EEIs) are producing engineering graduate, post-graduates and Ph.D. in a huge amount per year. Simultaneously the downgrading of quality education has been observed. Thus a need arises to identify the quality improvement factors to enhance quality of EEIs. For this purpose a study was conducted in two phases in EEIs situated in Chhattisgarh State of India. In the first phase, TQM methodology was applied to understand the engineering education institute requirements and critical success factors for enhancing quality were identified through a comprehensive literature survey and expert opinion for the development of quality improvement framework. In the second phase, a fuzzy-Kano approach was applied for categorization of identified factors as attractive, must-be and one-dimensional. Furthermore, the fuzzy Kano model suggested that factors like Amenities, Serviceability, MIS, and Accessibility of Faculties are must-be for providing quality education while Research & Consultancy, Training & Placements, Stakeholders Satisfactions, Global Synergy and Evaluation System are attractive factors in enhancing education quality. Whereas factors like Management Responsibility, Infrastructure & Resources, Quality Enhancement cell, Industry–Institute Collaboration, Alumni-Associations and Demographic Location of Institute are one-dimensional factors whose presence increase education in proportion. This study could be useful to develop a quality improvement framework for various EEIs for enhancement their education quality standard. This would be a benefit for all the stakeholder of EEIs in many perspectives such as gaining reputation and attracting more masses to particular EEIs.

Keywords— Engineering Education Institutes (EEIs), Education Quality, Quality Improvement Framework, Total Quality Management (TQM), Fuzzy Kano, Chhattisgarh

I. INTRODUCTION

India has witnessed huge expansion in number of EEIs in last 10-15 years. Owing to this, a large number of engineering graduates, post-graduates and Ph.D. are being produced each year. However, this growth is not welcomed growth due to lack of quality output from these EEIs. Simultaneously downgrading of quality has been observed. Now a day's EEIs are stands in a very low position due to the shortage of interested students who really want to take admission in engineering institutes due to decline trend of the carrier in engineering sectors as. Unemployment is major issues for this problem. The aim of EEIs should be to develop a world-class technology platform for their students, having the required skills and knowledge and ensure the quality and reliability of engineering graduate students by optimal utilization of resources. In Chhattisgarh State of India, various engineering educational institutes in spite of having standardization such as ISO 9001:2000 quality management system (QMS) and National Board of Accreditation (NBA) certificates fails in providing quality education due to lack of implementation of knowledge about quality concepts. Unfortunately, the overall quality of education in most of the EEIs is not satisfactory. Thus, there is a need to develop a systematic approach and standard framework for quality improvement which can provide theoretical as well as practical skills which required by the industry from engineering students. Hence, requirement of the quality improvement technique such as TQM to improve the quality of EEIs and develop a standard framework for improvement in the quality of education is needed.

In this work, nineteen criteria and seventy-eight sub-criteria have been proposed to enhance quality of education in EEIs. The criteria were selected from through literature review and with the help of expert's opinion. A quality improvement framework has been developed to bring enhancement in quality of education. The developed framework would help to satisfy the need of faculty, students and other management peoples regarding improving quality of education. This paper aims to presents the result of a case study conducted on EEIs situated in Chhattisgarh, India through a series of the questionnaire.

The data have been collected through questionnaire survey with 164 educational experts. The responses were taken using fuzzy methodology which overcomes the limitation of crisp approach since there is ambiguity between responses and respondents can choose only one response in traditional crisp approach. Whereas in the proposed fuzzy approach, the response can give any number of response on Likert scale in percentage and the summation of all response for a particular question should be exactly equal to 100%. This result in more accurate response and thus provide good results. Further based on response the factors were categorized as per Kano Philosophy as attractive, must-be, one-dimensional, neutral, live with and dislike. To this regard the pool of 19 questions with each question having two parts (positive and negative) were asked to the Professor, Associate Professor and Assistant Professor of various EEIs situated in Chhattisgarh, India. The responses were collected and converted into fuzzy numbers. The case study was conducted in two-phase, first phase application of TQM was used to understand the engineering education institute requirements and critical success factors for enhancing quality were identified through a comprehensive literature survey and expert opinion for the development of quality improvement framework.. In the second phase, fuzzy Kano approach was applied for categorization of identified quality improvement factors for quality enhancement in EEIs.

A. Role of engineering education institutes in India

In India, most of the engineering educational institute imparts undergraduate and graduate courses in engineering and sciences. They offer a degree in engineering such as Bachelor of Engineering, Bachelor of Technology, etc. The primary objective of EEIs is to develop a world-class technology platform for their students to have the required skills and knowledge and ensure the quality and reliability of engineering graduate students by optimal utilization of resources. The base of technical education in India has brought from British rulers. The first engineering education institute was established in the Uttar Pradesh in 1847, then after the three more engineering educational institutes came in knowledge in 1856. Present more than 10396 EEIs are situated in India, resulted the unnecessary existence of engineering education institutes in the market and the quality of education has been degraded. India produces every year the largest amount of engineering graduate students per year in the world. Thus more than 75% engineering graduate students are unemployed due to lack of required knowledge and skills as per required by industries. The current competitive market requires skills to serve employee in the industry or another sector to get a suitable job. In survey found 7-8% of engineering graduate students found fit for the employment (Sahney, 2011) [1]. This situation occurred due to non-availability of required knowledge and skills in students. The various reasons have behind these issues are lack of management responsibility, infrastructure, and resources, lack of training and placement, improper educational system etc. in EEIs.

B. TQM in engineering education institute

Total Quality Management (TQM) concept has been brought by quality gurus like Crosby, Ishikawa, Deming, Feigenbaum, Juran and other quality peoples with their new quality concept, principles, and practice. It works on the management principles with a set of quality improvement processes such as organization mission, vision, objectives, manpower, customer satisfaction through a continuous focus on customer requirements and their needs. The term TQM is the integration of three words, ‘T’ refers to the whole; ‘Q’ refers to the excellence of product or services, and the term 's ‘M’ refers to the art of managing, controlling, and planning towards continues improvements on quality of the organization. TQM in engineering educational institute implies the continues improvement on the quality of learning through world-class teaching-learning process, quality of courses, resources, student support systems, instructional process, management involvement towards both student and employees satisfaction with the goal to achieve excellence in quality or services. With application of TQM concept and their principles in EEIs would result enhancing quality of education, student-employees satisfaction, an improvement on educational process and continues involvement through top-level management.

II. LITERATURE REVIEW

The literature review has been presented in the domain of engineering education institutes (EEIs) and quality improvement in various higher education institutes (HEIs) and general of fuzzy Kano model.

A. Literature review on engineering education and higher education

In the perspective of various HEIs and EEIs are struggling in education quality and thus have resulted in downgrading of education quality. To enhance the quality of education various models have been proposed by the author [2-3] and it was strongly felt that the various quality management tools would certainly enhance the quality of education. The authors have developed quality education model combining with various quality education factors in higher education as well as engineering education [2-9]. Sahney et al. (2006) [10] have been used twenty-four criteria to develop an integrated quality framework for education. The study aimed to identify design characteristics which would overcome the voice of the customer. The study used SERVQUAL, QFD, ISM and path analysis approach to identify design characteristics for improve education quality.

Sahu et al. (2008) [7] enlist the factors which affect the quality of technical education and develop a mathematical model to measure effectiveness of factors for quality improvement. Sahney & Thakkar (2016) [3] presented an integrated approach to evaluating the performance of technical education institutes. The study was performed for four selected technical institutes to evaluate their efficiency and effectiveness. The five criteria have been taken as teaching quality; research quality; market share of students; administration; infrastructure facilities to development of quality framework in higher education institutes. The two integrated methodology; Data Envelopment Analysis (DEA) and Analytical Hierarchy Process (AHP) were used for comparing and evaluation of efficiency based on their input and output in technical education institutes. At last, they identified the most efficient institute among four selected institutes with related criteria; academic efficiency, research efficiency, teaching efficiency, and consulting efficiency.

Pandi et al. 2009 [4] proposed an integrated TQM framework for world-class education. The study was conducted in self-finance technical institutes situated in Tamil Nadu, India. The study investigated the level of performance through student perception. The data was collected from 250 students through survey of selected technical institutes. The developed framework consisted the seven critical parameters; Top Management Commitment (TMC), System Approach to Management (SAM), Customer Satisfaction (CS), Employee Involvement (EI), Training (TRG), Team Work (TW) and Continuous Improvement (CI). The t-test was employed to obtain perception of faculty and students.

Jain et al. (2011) [6] developed a model to identify service quality in higher education. The model consists of several factors categorized under two categories: program quality and quality of life. Pandi et al. 2012 [11] proposed a conceptual model of integrated educational quality management system (IEQMS). The integrated IEQMS model consisted 10 critical factors as top management commitment; system approach to management; customer satisfaction; employee involvement; training; teamwork; continues improvement; corporate social responsibility; academic culture; knowledge audit in order to increase wealth and profit of an engineering institution performance. Sahney, S. (2011) [1,9] presented result of case study was conducted on management institute situated in India to evaluate service quality. This was performed in three phases: SERVQUAL technique was applied to evaluate service quality in first phase; Kano model was used to categorize design requirements in second phase and QFD was used to design the requirements as per voice of customer. Sudha, T. (2013) [12] introduced the implementation of Total Quality Management principles towards the improvement in various higher education institutions. Akdag and Zaim (2012) [13] developed a conceptual model to improve quality of higher education. The study was conducted on higher education institutes situated in Istanbul, Turkey. The proposed model integrated with six variables and 19 sub-variables used to quantify student satisfaction level. They considered two types of attributes; student satisfaction and dissatisfaction in this study. The TQM and SERVQUAL technique was used to improve quality of education in higher education institutions.

Sahney, S. (2016) [14] developed the integrated customer-centric model for enhancing the quality of management in the higher education sector. The study was conducted in engineering and management institutes for both internal and external customer of the education system. The developed model used TQM concept to include two criteria as customer requirement and design characteristics. The customer requirement consisted tangibles; attitude; content; competence; delivery; reliability and the design characteristics consisted management system; technical system; social systems. The main aim of this study was to prioritize improvements of service based on the voice of customer (VOC). The study used SERVQUAL approach to evaluate service quality of educational institute, QFD used for identifying design characteristics as per customer requirements. The author also used ISM and path analysis approach used to identify and prioritize design characteristics based on both customers VOC.

Kruger and Ramdass (2011) [15] introduced TQM principles and its guidelines to fit in higher education to improving education quality. The seven dimension was used for service quality improvement in higher education are convenience; reliability; responsiveness; time; assurance; courtesy; tangibles. Venkataram and Giridharan (2007) [16] designed a system for assessment of technical education quality. The study developed TEQ-AA system which helped to analyze institution standard quality with information provided online in web pages. The developed TEQ-AA system was integrated with five educational inputs as recourse; knowledge; technology; social needs; technology in order to improve quality of technical education system. The system helped in assisting students for selection of colleges during their admission stage in Karnataka State of India.

Debnath and Shankar (2012) [17] employed ISM to identify enablers and barriers of technical education. After a comprehensive literature review and discussion with expert, nineteen criteria were finalized this study to develop a quality improvement framework for implementation of TQM in EEIs. The criteria are defined by the following definition and its adaptation by the various authors in their studies towards the improvement of quality in education and their details are shown in Table 1.

S.No.	Criteria	Concerned activities/definition	Source
1	Management Responsibility	Handling activities such as Planning, budgeting, coordination, staffing, organizing, monitoring, feedback and performance review of system etc.	Sahu et al., 2008; Tulsi and Poonia, 2015; Khanna et al., 2011; Pandi et al., 2009;
2	Infrastructure and Resources	Fundamental facilities such as water supply systems, electrical systems, well equipped labs, classrooms, library, hostel, accommodation, playground etc.	Sahu et al., 2008; Sahney and Thakkar, 2016; Jain et al., 2011; Ramachandran et al., 2013; Khanna et al., 2011;
3	Quality Enhancement Cell	To enhance, maintain and monitor the quality of the organization.	Debnath and Ravishankar, 2012
4	Research and Consultancy	Service to society through offering consultancy projects, efforts to bring noval and innovative ideas for betterment of humanity.	Sahu et al., 2008; Sahu et al., 2012; Khanna et al., 2011 [27]; Ramchandran et al., 2013
5	Institute Culture	A working tendency of the organization so that every employee easily adapts changes required for the current competitive scenario.	Sahu et al., 2012
6	Industry-Institute Collaboration	The memoranda of understanding between Institute and industries to bring both sides emotionally and strategically together for betterment of society.	Sahu et al., 2008; Jain et al., 2011; Khanna et al., 2011; Ramchandran et al., 2013
7	Alumni-Associations	The union of graduates, postgraduates or, more broadly, of passed out students for development of institute and individuals.	Sudha, T., 2013, Sahney S. (2011a),
8	Audit	Monitoring by standard bodies such as NBA, NAAC, ISO for evaluation of performance of institute	Lock, 1999; Sahney et al. (2008) [28]; Sahu et al. (2013) [29]
9	Training and Placement	The facilities of setting up of internship, training program and placement in leading organizations for graduating student from the Institute.	Sahu et al., 2012; Sahney and Thakkar, 2016; Jain et al., 2011;
10	Social Responsibility	A duty where every person has to perform an ethical task, so as to maintain a proper balance between the economy and ecosystem.	Tulsi and Poonia, 2015;
11	Stakeholders-Satisfaction	Provide right things at a right time to customers towards fulfilling their expectations	Sahu et al., 2008; Tulsi and Poonia, 2015; Sahney et al. (2010),
12	Demographic locations of Institute	Connection of the institute to outer world through physical infrastructure and geographical climatic conditions	Jain et al., 2013; Sahney et al. (2008),
13	Amenities	Desirable facilities such as cafeteria, computer centers, internet systems, post-office, banks, gym, dispensaries etc.	Jain et al., 2013; Sahney et al. (2008), Sahney S. (2011a),
14	Serviceability	Ease to solve the any problems effectively such as complaint addressability, and reparability of any faulty systems etc.	Experts Opinion
15	MIS	Provision of institute web portal, online attendance, results, digital access to resources and notices	Expert Opinion
16	Global Synergy	Coalition with foreign institutions for sharing of resources in terms of exchange programs and collaboration with various activities.	Sahney S. (2011a), Sahney S. (2011b),
17	Accessibility of Faculty	The ease with faculty members are available to students to help them in their overall development	Sahney et al., 2006
18	Moral /Ethical Learning	Ability to learn about the principle of right and wrong concept.	Experts Opinion
19	Evaluation System	Provision to evaluate results for assessment of continuous performance	Experts Opinion

B. Literature review on fuzzy Kano approach

Fuzzy logic or fuzzy theory was developed by Zadeh in 1965 to extend the traditional set-theory. The fuzzy set theory is useful in capturing useful insight from system having vague ideas. Kano model was developed by Prof. Kano in 1984 to incorporate customer requirement during product development phase. Lee and Huang (2009) [18] proposed a new fuzzy concept for Kano model. The fuzzy Kano model criticized the questionnaire and evaluation table of customer requirement conducted by Kano. The study used fuzzy approach to modify questionnaire in fuzzy two-dimensional form. It also presented mathematical calculation based on the model. A case example survey of Taiwan district theme park service quality was used to show the difference between traditional Kano models with fuzzy Kano model. Wu and Wang (2012) [19] proposed a continuous fuzzy Kano model for classifying criteria of customer requirement.

Vinodh et al. (2013) [20] presented a model for sustainability assessment. The study used fuzzy Kano model for assessment of the sustainability of an automotive organization. The case study was conducted in Indian automotive parts manufacturing organization situated in Trichy, Tamilnadu. Lee et al. (2008) [21] presented a fuzzy integrated approach for evaluating customer requirement weights for PLM system. The study was conducted with PLM users in Taiwan high tech information electronics industry to classify customers' requirements. The study used fuzzy Kano model and QFD to evaluate CRs. The data were obtained for evaluation with CRs based on an interview with industry experts. The responses were received from 50 experts included five professors from colleges, fifteen PLM experts consultants and thirty were senior level manager research personnel. Pai et al. (2016) [22] presented a combined approach to classify service quality of a restaurant. The study used Kano and Importance-Performance Analysis (IPA) model for the investigation of critical service quality.

Bu and Park (2016) [23] presented a fuzzy model for minimizing the overriding effect of 'indifferent' category in Kano Model. Lopez and Jeronimo (2012) [24] developed an integrative framework for managing logistics customer service. The developed framework integrated Kano model, fuzzy distance, and two-tuple fuzzy linguistic model for managing customer service in logistics. Chyu and Fang (2014) [25] presented a fuzzy approach to solve the product development selection problem. The proposed fuzzy model integrated with fuzzy Analytical Network Process (FANP), fuzzy Kano and Fuzzy Decision Making Trial and Evaluation Laboratory (DEMATEL). The FANP approach used to make interdependence among attributes and mapped identified relationship. The fuzzy Kano and DEMATEL were used to evaluate criteria and the developed relation between them. The study illustrated with a real-life example. They also used TOPSIS and Gray Relation for comparative analysis.

Wang, C. H. (2013) [26] presented a hybrid framework for addressing critical issues related to new product development. The study used two critical issue; customer satisfaction and product configuration. The fuzzy Kano integrated with TOPSIS approach were used for decision making in product development and fuzzy Kano model used for analyzing the customer requirements based on product criteria. The case study was conducted on smart pads to justify the proposed framework. From above literature, we see that fuzzy-Kano approach has wide application and thus can be used in education sector to get better judgement and hence improvement in decision making.

III. RESEARCH GAP

There is a continuous decrease in admission of students in EEIs of almost all state of India. The state of Chhattisgarh has same graph in this regard. The reduction occurred due to lack of output in terms of employment from these EEIs. The main reason for this un-employment is non-availability of knowledgeable and skilled students. Also the required skills and knowledge as per industry expectation from engineering graduate students could not be implanted by the institution. Hence there is a huge gap between actual requirement of industry and availability of skilled students. While vacancies are available in the market but due to non-availability of right engineering student in current market, industry could not fill up those vacancies. According to (Sahney, 2011) [1] 7 to 8 % engineering graduate students are having the knowledge and skills to serve employment in industry to fulfil their requirements. This concept is mainly due to lack of proper implementation of quality improvement framework in EEIs. The highly reputed institutions are able to fill up their seats and other remaining institutions had to keep waiting for students. As a remedy to such type of situation, TQM approach has been used to understand actual requirement of EEIs and evaluate educational quality with development of quality improvement framework and fuzzy Kano model has been employed to prioritize the most suitable factors in terms of the actual need of institutions to ensure the quality improvement of education.

A. Research Methodology

Kano et al. (1984) developed and proposed a framework which helps in prioritizing the improvement of a product or services. The proposed model can identify and prevent customer dissatisfaction if present. Kano categorizes improvement criteria as per their ability to fulfill customer satisfaction level. In this model customer needs are categorizes into five categories; must be, attractive, one-dimensional, in-different and Reverse attributes.

The Kano model is shown in figure 1. The fuzzy Kano approach is used as an effective tool for classifying customer requirement in very specific manner. It is a two-dimensional quality approach that analyzed the actual need of customer in the perspective of product or services and the customer satisfaction level from their services. Based on the received responses from a customer in a two-dimensional manner, a need arises to classify into Kano categories. Proper responses were obtained using fuzzy approach. The Kano methodology focused on the relationship between customer satisfaction and performance of product or services. The Kano questionnaire consists of two parts; functional and dysfunctional forms of questions.

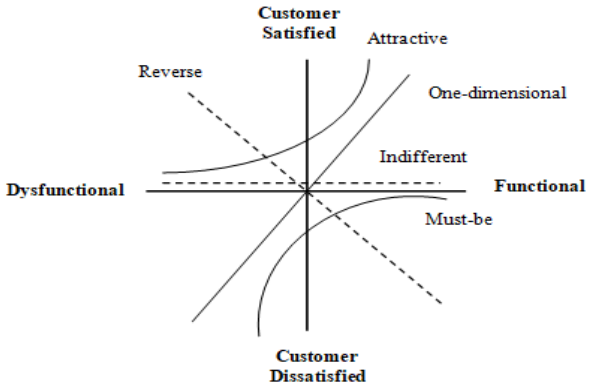

Figure 1. Kano model

TKQ survey

	Like	Must-be	Neutral	Live-with	Dislike
Functional	.....	..✓...	.....	.....	.....
Dysfunctional	.....	.....	..✓...	.....	.....

Fig.2 Single value of customer response in case TKQ survey

FKQ survey

	Like	Must-be	Neutral	Live-with	Dislike
Functional	20%	. 30%	50%	.....	.....
Dysfunctional	.....	.....	.....	.. 50%	50%

Fig.3 Multiple values of customer response using FKQ

In traditional Kano survey, people can give one answer from the survey which list of five choices including like, must be, neutral, live with, and dislike. But in the fuzzy Kano survey, people can give answers in percentage or values according to five choices. The sum of the values of response should be 100% in FKQ survey. However fuzzy Kano questionnaire reflects the voice of customer clearly and accurately than traditional Kano questionnaire. The detailed figure of TKQ and FKQ is shown in figure 2, 3. The fuzzy Kano model fits for modern requirement due to its higher flexibility because it allows interviewee with the personalized standard to answer the question. This both TKQ and FKQ type of survey are used to get customer response about their product or services. Kano model classifies services excellence into five categories and the details are:

1. 'Must-be' attributes – this attributes are needed for customers. The attributes do not increase the satisfaction of the customer but in the case of absence increase the level of dissatisfaction.

2. 'One-dimensional' attributes – this attributes increase the level of customer satisfaction.

3. 'Attractive' attributes – this type of attributes can increase the customer satisfaction but in case of absence do not affect the level of customer satisfaction.

4. 'In-different' attributes – the presence or absence of this type of attributes does not affect customer satisfaction level.

5. 'Reverse attributes – the absence of this category of attributes increase the level of satisfaction because the customer does not want the presence of this type of attributes in the product.

IV. CASE STUDY

A. Identification of factors

The factors for bringing improvement in the quality of EEI_S have been taken with the help of educational experts and literature reviews. However, nineteen criteria and seventy-eight sub-criteria was selected for improving quality of education and shown in Table 2.

Table 2. Criteria/parameters critical to quality of educational institute

S.No.	Criteria	Subcriteria			
1.	Management Responsibility	1. Leadership 2. Strategic planning 3. Customer focused 4. Well defined Mission, Vision	5. Course objectives 6. Policy and Procedure 7. Channels of Communication	8. Budgetary Resources(finance) 9. Feedback from Stakeholders	10.Performance Review and Measures 11.Recordkeeping
2.	Infrastructure & Resources	12. Proficient Faculty and Staff	13. Well-equipped Labs, Classrooms, Library	14. Well-furnished Accommodations 15. Internet Facilities	16. Playground
3.	Quality Enhancement Cell	17. FDP and SDP 18. Student Progress Monitoring	19. Continuing Education Cell 20. Counselling and Grievance cell	21. Content beyond Curriculum	22. Skill Development Programme
4.	Research & Consultancy	23. M Tech Programs 24. Ph.D. Programs	25. R & D Cell 26. Patents	27. Research publications	28. Projects 29. Consultancy
5.	Institute culture	30. Continuous improvement(Zero – Defect)	31. Employee involvement (kaizen, Innovations)	32. Reward and Recognitions 33. Adaptability to Change	34. Competitive Environment
6.	Industry –Institute Collaboration	35. MOU with industries and other esteem institutes.	36. Improve the curriculum through industry Collaboration.		
7.	Alumni-Associations	37. Resource developments	38. Placements	39. Extracurricular activities	
8.	Audit	40. Internal audit	41. External audit (NBA,NAAC)	42. ISO 9001:2000	
9.	Training & Placements	43. Students Training-Organising of training activities/Workshop etc. for student placement	44. % of Students placed	45. Average Package Placements of Students	
10.	Social Responsibility	46. Society	47. Local surroundings development		
11.	Stakeholders Satisfactions	48. Industry/ Entrepreneurs	49. Management 50. Alumni	51. Parents 52. Faculty and staff	53. Students
12.	Demographic locations of Institute	54. Climate	55. Connectivity to Road/Railway/Air		
13.	Amenities	56. Cafeteria 57. Gymnasium	58. Post office 59. Bank	60. Bus facility 61. Guesthouse	62. Dispensary
14.	Serviceability	63. Complaint handling	64. Attitude of staff		
15.	MIS	65. Website/Web portal of institute	66. Online attendance & Results of Students	67. e-notices/e-tenders Amenities	
16.	Global Synergy	68. Tie up with Foreign University	69. Diploma /certificate course of Foreign University	70. Faculty Exchange Programs	
17.	Accessibility of Faculty	71. Attitude of faculty	72. Capability of Problem Solving Approach		
18.	Moral /Ethical Learning	73. Spiritual Workshop	74. Yoga/Meditation Sessions –Experts	75. Moral Character Building Environment	
19.	Evaluation System	76. Faculty-Assessments	77. Staff - Assessments	78. Student-Assessments	

B. Case Description

In order to implement TQM and evaluated fuzzy Kano concept to improve quality in Engineering Education Institute (EEI_S), a case study presented in this section. The implementation of TQM model for bringing improvement in the level of education quality, a survey was conducted in the EEIs situated in Chhattisgarh, India region. The criteria for improve education quality is discussed in Table 2. The developed quality improvement framework is shown in figure 4.

C. Application of fuzzy Kano in survey

The survey consists of collecting responses from seven EEIs of Chhattisgarh out of which 1 EEI was College of National Importance, 2 EEIs were government colleges and 4 EEIs were private. The questionnaire was prepared for improved quality based on factors discussed in Table 2 and responses were taken using fuzzy approach. The questions were asked in two different manners and it was analyzed in two stages. In the first stage, the questionnaire was mailed to respondents consisting of Professor, Associate Professor and Assistant Professor and their responses were noted down. In the second stage, the responses were analyzed through the fuzzy-Kano approach and quality attribute were categories in different categories as per fuzzy Kano evaluation.

D. Data collection & analysis

A total 320 questionnaire was mailed out of which 182 responses were received. But out of these received responses, 18 were rejected due to incomplete or vague responses. Finally, 164 responses were found suitable for our study. The sample of the questionnaire is shown in table 3. The fuzzy Kano evaluation is shown in Table 4.

Table 3. Questionnaire for Quality assessment in EEIs

S. No.	Type of questions	Question	Like	Must be	Neutral	Live with	Dislike
1	Functional	How would you feel if management is actively involved in quality enhancement of Engineering Education Institute (EEIs)?	100%				
	Dysfunctional	How would you feel if management is not actively involved in quality enhancement of Engineering Education Institute (EEIs)?			33%	33%	34%
2	Functional	How would you feel if EEI are equipped with state of the art infrastructure and resources?	50%		50%		
	Dysfunctional	How would you feel if EEI are not equipped with state of the art infrastructure and resources?		50%		50%	

Table 4: Kano Evaluation Table

	Dysfunctional Questions				
Functional Questions	Like	Must-be	Neutral	Live With	Dislike
Like	Q	A	A	A	O
Must-be	R	I	I	I	M
Neutral	R	I	I	I	M
Live With	R	I	I	I	M
Dislike	R	R	R	R	Q

Notes: Q:Questionable; A:Attractive; O:One-dimensional; R: Reverse; I:Indifferent; M:Must-be Source: Matzler and Hinterhuber (1998).

Step for sample calculations:

1. For each question, consider the responses of functional questions as row vector for e.g. {0.67, 0.22, 0.1, 0.01, 0}.
2. Similarly consider dysfunctional question as another row vector for e.g. {0, 0, 0.04, 0.36, 0.6}.
3. Take the transpose of a dysfunctional row vector and multiply with functional row vector. A new matrix of 5 X 5 will be received.
4. Compare the obtained matrix with Kano evaluation table.
5. Add the corresponding values and represent in the form $A = \{\frac{0.198}{M}, \frac{0.264}{A}, \frac{0}{R}, \frac{0.1327}{I}, \frac{0}{Q}, \frac{0.402}{O}\}$
6. Whichever values is higher, the corresponding questions go to that criterion. For example for this problem the factor would go under one-dimensional.

Repeat step 1 to 6 for all questions and for all respondent one by one.

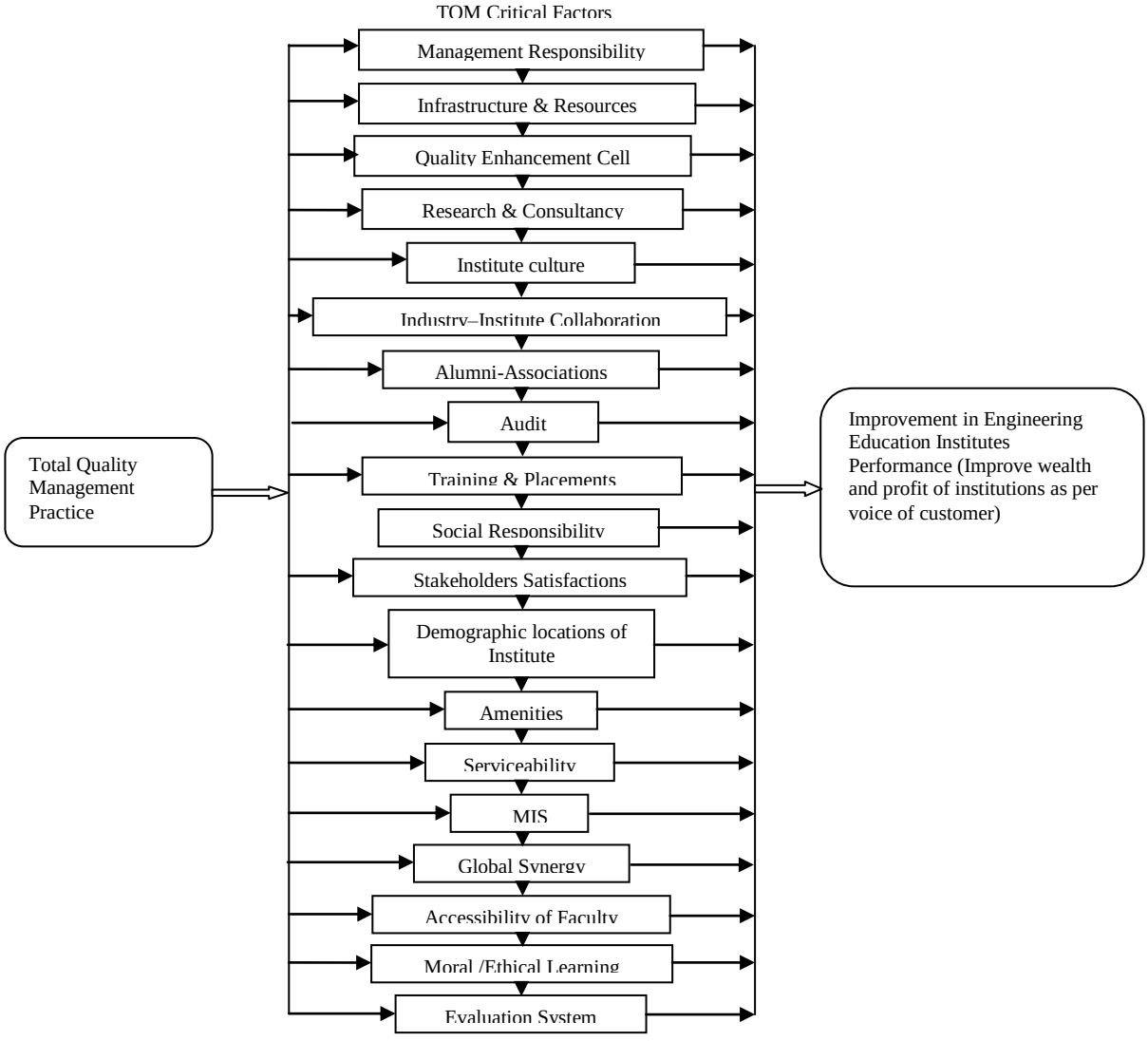

Fig 4. A framework for quality improvement of EEIs

V. RESULT AND DISCUSSION

For this survey since the no. of respondent were high, following these step will result in the cumbersome process. Instead of this we took the average of responses for a single question and applied the above methodology. Similarly, other questions were encountered. Finally, these factors were categories as suggested by Kano. The further extent of respondent satisfaction and dissatisfaction were found using methodology given by Berger *et al.* (1993). This shows the extent to which presence of a factor creates satisfaction while absence creates dissatisfaction.

Table 4 shows the detail categorization of the attribute as per Kano methodology. Further, from six categories of Kano evaluation table, only three were considered and other three were omitted. The omitted categories were questionable, indifferent and reverse category since factors belonging to this category are not helpful to enhance service quality in EEIs.

Table 4. Categorization of attribute

										Customer Satisfaction	
										Extent of satisfaction	Extent of dissatisfaction
		Respondent replies in percentage								(A+O)/(A+O+I+M)	(M+O)/-(A+O+I+M)
S.n	Attributes	M	A	R	I	Q	O	Total	Category		
1.	Management Responsibility	0.198	0.264	0	0.1327	0	0.402	1	O	0.668	0.602
2.	Infrastructure & Resources	0.252	0.2413	0.0005	0.1976	0.0006	0.308	1	O	0.549	0.560
3.	Quality Enhancement cell	0.2604	0.2175	0.0022	0.1576	0.0029	0.3596	1	O	0.579	0.623
4.	Research & Consultancy	0	0.57	0.0022	0.38	0.033	0	1	A	0.6	0
5.	Institute culture	0.0475	0.0475	0	0.9025	0	0.0025	1	I	0.05	0.05
6.	Industry - Institute Collaboration	0.241	0.2397	0	0.1632	0	0.354	1	O	0.595	0.596
7.	Alumni-Associations	0.2321	0.2541	0	0.1729	0	0.3409	1	O	0.595	0.573
8.	Audit	0.3729	0.1129	0	0.4121	0	0.1021	1	I	0.215	0.475
9.	T & P	0.218	0.276	0	0.191	0	0.315	1	O	0.591	0.533
10.	Social Responsibility	0	0.0414	0.0954	0.8586	0.0046	0	1	I	0.046	0
11.	Stakeholders Satisfactions	0	0.3297	0.1797	0.2753	0.2153	0	1	A	0.545	0
12.	Demographic locations of Institute	02193	0.2773	0	0.2	0	0.3028	1	O	0	1
13.	Amenities	0.2731	0.228	0	0.2471	0	0.252	1	M	0.481	0.527
14.	Serviceability	0.2751	0.2261	0	0.2519	0	0.2469	1	M	0.473	0.522
15.	MIS	0.2953	0.2074	0	0.2247	0	0.2726	1	M	0.48	0.568
16.	Global Synergy	0.1993	0.302	0	0.225	0	0.271	1	A	0.574	0.471
17.	Accessibility of Faculty	0.2798	0.2218	0	0.2462	0	0.2522	1	M	0.474	0.532
18.	Moral /Ethical Learning	0.196	0.2971	0	0.3309	0	0.176	1	I	0.473	0.372
19.	Evaluation System	0.0487	0.5206	0	0.3604	0	0.0703	1	A	0.591	0.119

Table 5: Classification of attribute into attractive, must-be and one-dimensional

Attractive	Research & Consultancy, Training & Placements, Stakeholders Satisfactions, Global Synergy and Evaluation System
Must-be	Amenities, Serviceability, MIS, and Accessibility of Faculties
One-dimensional	Management Responsibility, Infrastructure & Resources, Quality Enhancement cell, Industry – Institute Collaboration, Alumni-Associations and Demographic Location of Institute

Factors like Research & Consultancy, Training & Placements, Stakeholders Satisfactions, Global Synergy and Evaluation System were categorized as attractive in enhancing quality in EEIs. This is very much practical also since these factors attract stakeholder to the EEIs. Even different accreditation agency considers these for ranking of EEIs. These factors are very important to improve the quality level of EEI_S without this quality cannot be quantified. These attributes were obtained by fuzzy Kano-based on responses received by the educational experts so these attributes were recommended high value as per expert perception for improving the level of education quality. It was also reported that factors like Amenities, Serviceability, MIS, and Accessibility of Faculties fall into a must-be attribute for enhancing quality in EEIs. This could be justified by the facts that stakeholders often search for these attribute while choosing EEIs. For e.g. web-portal and online monitoring of stakeholder's interest are must for their satisfaction which when fulfilled enhance the quality in EEIs. Few factors were reported as one-dimensional such as Management Responsibility, Infrastructure & Resources, Quality Enhancement cell, Industry – Institute Collaboration, Alumni-Associations and Demographic Location of Institute. As the presence of these factors enhance the quality of EEIs while the absence of these creates dissatisfaction. For e.g. if management is responsibly handling their assigned duties, the institute prospers while their uninterested creates downfall in the system as well.

VI. CONCLUSION

This paper attempts to identify the factors/attributes responsible for enhancing the quality of EEI in the Chhattisgarh region of India. To improve education quality level, TQM philosophy is used. Large numbers of factors were surveyed through literature, discussion with academic experts and through a pilot study. A total of 78 factors were analyzed for this study. These factors were selected with the help of educational experts and literature reviews based on TQM concept. Further, these factors were grouped into mainly nineteen main factors. These nineteen factors were further classified into different categories as per Kano methodology. For this purpose, a fuzzy-Kano approach was used. The questionnaire was floated to different academic practitioners such as Professors, Associate Professors and Assistant Professors in different EEI_S situated in India, Chhattisgarh.

The analysis of data showed that factors like Research & Consultancy, Training & Placements, Stakeholders Satisfactions, Global Synergy and Evaluation System were grouped into an attractive category. While Amenities, Serviceability, MIS, and Accessibility of Faculties were Must-be attributes for enhancing the quality of EEIs in Chhattisgarh. Management Responsibility, Infrastructure & Resources, Quality Enhancement cell, Industry – Institute Collaboration, Alumni-Associations and Demographic Location of Institute were a one-dimensional attribute. This study could be useful to EEIs in framing education policies to improve the education quality.

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