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QFD AND FUZZY KANO MODEL-BASED APPROACH FOR PARAMETERS OF ACCREDITATION OF ENGINEERING INTUITIONS IN INDIA

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Abstract
This study proposes the application of Quality Function Deployment (QFD) and the Fuzzy Kano Model-based approach for evaluating and accrediting engineering institutions in India. The aim is to enhance the accreditation process by considering a comprehensive set of parameters and stakeholders' expectations. The QFD methodology facilitates the identification and prioritization of parameters by aligning the requirements of various stakeholders, including students, faculty, industry, and society. By incorporating stakeholder perspectives, the accreditation process becomes more inclusive and ensures a more holistic evaluation of engineering institutions. Additionally, the Fuzzy Kano Model is integrated to assess the satisfaction and dissatisfaction levels associated with different parameters. This model classifies parameters into categories such as basic, performance, excitement, and indifference, based on their impact on stakeholder satisfaction. By leveraging the Fuzzy Kano Model, the accreditation process can focus on addressing areas that have the potential to enhance stakeholder satisfaction and rectify shortcomings that may lead to dissatisfaction. The utilization of QFD and the Fuzzy Kano Model-based approach offers several benefits to engineering institutions in India. It enables a data-driven and transparent assessment process, encourages continuous improvement, and promotes a student-centric and industry-relevant approach. By embracing these methodologies, engineering institutions can strive for excellence, produce competent graduates, and contribute to the growth and development of the engineering industry in India.

Keywords: - Engineering Education, NBA, QFD, Fuzzy Kano model

Introduction

Engineering education in India has a significant impact on the country's overall education system and economy. India is known for its large number of engineering institutions and graduates, producing a substantial workforce for various industries. Indian engineering institutions offer a wide range of disciplines, including computer science, electrical, mechanical, civil, chemical, aerospace, and more. Students can choose their preferred specialisation based on their interests and career aspirations. Engineering programmes in India typically follow a four-year undergraduate format, leading to a Bachelor of Technology (B.Tech.) or Bachelor of Engineering (B.E.) degree. Some institutions also offer integrated five-year programmes that combine undergraduate and postgraduate studies, leading to a dual degree. Engineering curricula in India are designed to provide a strong foundation in core subjects such as mathematics, physics, and engineering sciences. The programmes also include

theoretical and practical coursework specific to the chosen discipline. Some institutions have started incorporating industry-oriented courses and projects to bridge the gap between academia and real-world applications. The National Board of Accreditation (NBA) and the All-India Council for Technical Education (AICTE) are responsible for accrediting engineering programmes and institutions in India. Accreditation ensures that the programmes meet defined standards of quality and relevance. Engineering graduates in India have a good chance of securing employment in various sectors, including information technology, manufacturing, telecommunications, construction, research and development, and more. Institutions organise campus placements, and many students receive job offers before completing their degrees. Despite the strengths of engineering education in India, some challenges exist. These include the need for continuous curriculum updates to match industry requirements, improving the quality of faculty, promoting innovation and entrepreneurship, and addressing the issue of unemployment among engineering graduates. India boasts several renowned engineering institutions, including the Indian Institutes of Technology (IITs), the National Institutes of Technology (NITs), the Indian Institutes of Information Technology (IIITs), and numerous state and private universities. Outcomes-Based Education (OBE) is an educational approach that focuses on defining specific learning outcomes or competencies that students should achieve by the end of a course, programme, or educational experience. OBE emphasises the desired results of learning rather than just the content delivered or the amount of time spent in instruction. OBE begins with clearly defined and measurable learning outcomes. These outcomes describe what students should know, understand, and be able to do upon completion of a course or programme. Learning outcomes are typically specific, observable, and measurable, enabling teachers and students to assess progress and achievement. OBE places an emphasis on developing competencies or skills. Instead of focusing solely on knowledge acquisition, OBE aims to develop practical skills, critical thinking abilities, problem-solving capabilities, teamwork, communication skills, and other relevant competencies necessary for success in the real world. OBE shifts the focus from teacher-centred instruction to student-centred learning. It encourages active student engagement, self-directed learning, and the application of knowledge and skills in real-life contexts. Students are encouraged to take responsibility for their learning and become active participants in the learning process. OBE advocates for authentic assessment methods that align with the desired learning outcomes. Instead of relying solely on traditional exams and tests, assessments in OBE may include projects, portfolios, presentations, case studies, simulations, and other real-world tasks that require students to demonstrate their knowledge, skills, and abilities. OBE promotes a culture of continuous improvement in education. It encourages educators to regularly review and refine their teaching practises, curriculum, and assessments based on feedback from students, industry needs, and societal changes. OBE emphasises data-driven decision-making and evidence-based practises to enhance the effectiveness of education. Overall, Outcomes-Based Education focuses on clearly defining learning outcomes, developing relevant competencies, and assessing student performance based on these outcomes. It aims to create a student-centred and application-oriented learning environment that prepares learners for future challenges and

enables them to contribute effectively to society. For the assessment of quality education in engineering colleges, several factors are determined by the National Board of Accreditation (NBA). The mean concept of parameters is quality of education in terms of manners of teaching quality, physical infrastructure of colleges, modernization of campus programmes, and job-oriented skills for students. This study employs two models of customer behaviour and response, as engineering education is the product. QFD and fuzzy Kano model assessment of the quality factors of NBA and survey data from engineering colleges all over India. The rest of the article is organised as follows in Section II: Related Work in the Area of NBA and NAAC for Quality Education in Engineering Colleges in Section III, Research Methodology; in Section IV, Results and Discussion; and finally, in Section V, Conclusion.

II. Related work

The quality of private institutions must be raised because thousands of new colleges have opened up in the private sector, rather than the IITs and NITs, where the majority of the nation's future engineers will be educated. The curriculum (as well as teaching methods) should be restructured in light of labor market demands, which is another important issue that requires immediate attention. For instance, it is frequently recommended that engineering be combined with social sciences for a better job outlook, but this is still far from the case, especially in private institutions. The author [1] The National Assessment and Accreditation Council could use the updated manual of accreditation of medical sciences universities and institutions in India as a foundational reference document for the necessary policy framework as an additional step towards internalising medical education, as the quality centre contemplated therein would. For engineering colleges to strategically integrate their offers and marketing strategies with the needs and perceptions of potential students, the insights are crucial. Additionally, the study will be beneficial for foreign universities searching for group and individual opportunities in the Indian education sector. The author [3] Using statistical methods like SEM, this preliminary qualitative validation can be further empirically validated. To get a complete view of the enablers that can encourage workforce agility in higher education institutions, the study can be expanded to additional fields. In the beginning, the author [4]traces the development of final results-based training (OBE) and introduces important implementation standards. After that, it defines effects and explores how identifying consequences requires a paradigm shift. According to the author [5], the goal of this study is to establish a moral environment where Indigenous and non-Indigenous engineering educators can converse and share knowledge. We can enhance Indigenous methods of knowing, being, and doing in engineering education in Canada and around the world under the direction of Etymology. According to the author [6], the results of this study also show that the ranking and certification systems have a big impact on how well Indian higher education institutions perform. The study's findings are pertinent to all parties involved, including students, parents, educators, the academic community, the government, higher education investors, and society in general. For older higher education systems, the king and his authorities exercised direct control in ancient times. I.Q.A.C. plays a comparable role in connecting and comparing the quality and assurance of higher education in today's Indian universities and colleges in order to benefit the Indian government and society. The author [8]

This information society, often known as the knowledge society, is uninformed because technology silences the mind and prevents it from questioning itself. This might occur whenever we discuss mass education rather than class education. The development of curricula and improving evaluation within outcome-based Education (OBE) are discussed in this study. The author [9] The Statistics are from the 2018 national assessment of the quality of education in Colombia, and the study population is made up of 256 universities with engineering programmes in Colombia. Two universities with efficiency ratings of 92.3% and 97.3%, respectively, were found in the results. The author [10] The study's findings also showed that while the majority of HEIs viewed internationalisation as a crucial strategy and had been putting it into practise for the previous two to three years, many of them lacked a formal policy and had not incorporated it into their Mission or vision statements. The author [11] of the report suggested that all educational institutions take part in the global ranking system. The NIRF system will participate in the international participation process in order to encourage India to participate more actively there. The author [12] This initiative can be aided and promoted by identifying, exchanging, and developing best practices, teaching materials, and tools, as well as a plan for promoting it at universities. The main ideas and informative strategies that came up during the informal network meetings are presented in this study, and they are contrasted with current trends in the research literature. The author [13] The National Assessment and Accreditation Council (NAAC) and National Board of Accreditation (NBA), two organisations that examine institutional and programme standards, respectively, maintain the quality of higher education in India. The author [14] suggests that this pattern suggests that a significant number of the remaining institutions have increased their research and publication efforts and are also receiving their fair share of citations. It has also been noted that a sizable portion of NIRF-eligible applicants lacked any publications; nevertheless, from 2017 to 2020, the percentage of universities with „0" publications has been steadily declining. The author [15] The main difficulty that lies ahead is properly integrating the development of green skills into these programmes and courses. While raising awareness and fostering technological advancements, the need to convert TVET into Green TVET (GTVET), a more sustainable option, encourages the conversion of „ brown jobs into "green jobs." The author's [16] analysis of four years' worth of India Rankings data, from 2017 to 2020, on a variety of engineering-related HEI performance parameters offers an intriguing perspective and demonstrates that participating institutions are working very hard to improve their performance on a variety of parameters or sub-parameters identified under NIRF. The author [17] of the current article makes an effort to serve as a useful, insightful manual for College Libraries and Information centres getting ready for evaluation and certification by NAAC, Bangalore. The study also intends to be beneficial for librarians by addressing the potential methods by which librarians might assist in the institutional assessment and accreditation process of NAAC rather than focusing just on libraries. The author [18] It emphasises the need for a full overhaul and reconfiguration of the educational system, including the establishment of roughly 100 top-tier research universities with a stronger emphasis on high-quality research, all of which will be multidisciplinary independent universities or colleges led by committed academic leaders with

unwavering integrity. The author [19] illustrates the India Rankings life cycle, which includes various disciplines and their charts. It also emphasises how the framework is developing year by year based on the data that is accessible to institutions. Numerous changes and deviations occurred as a result of incomplete or inaccurate data entered by the Institutes. The author [20] This study will be beneficial to the institutions because it will allow them to concentrate on the performance of the important factors in order to improve their place in the NIRF charts. It will also be beneficial to the students because it will guide them in choosing the right university for them to attend. To learn more about staff and students' experiences with the SL programmes, focus groups were held with representatives from both institutions, and a qualitative case-study approach was adopted. The findings illustrate the participants' experiences in the two SL simulations. The study's findings also provide engineering educators with new perspectives. The author [22] There are also curriculum and process development for education's connection to the working world, complete equipment utilisation, a research environment, recruitment in educational institutions, technical policy upgrades, boosting standards, and adopting an institutional approach to excellence. The author [23] According to the current study, Peer perception, research, and professional practise (RP), both of which have a strong positive correlation with one another, are the main criteria that affect an institution's NIRF rating. In the essay [24], the author discusses a systematic method for evaluating graduates of a programme in an independent engineering college who completed OBE with CBCS. The author [25] says the study gives all parties involved in higher education a better grasp of the significance of accreditation during student enrolment. In order to evaluate the impact of accreditation during student enrolment in colleges and institutes in Pune city, very little research has been conducted to date. According to the author [26], the validity of the instrument was guaranteed by the factor loading, average extracted variance, and maximum shared variance values. The instrument's reliability was determined using the composite reliability ratings and Cranach's alpha value. The author [27] of this research study makes an effort to analyse the function and contributions of NAAC in maintaining a deeply established educational hub across the country and the efficient evaluation procedure used in higher education institutions all over India. The author's [28] ten QMS constructs, institutions, and quality metrics suggested by India's NBA national board of accreditation were used to generate the questionnaire. The data was examined using the SPSS 26.0 software to evaluate the measurement device and establish the student t-test and p-value. The author [29] tests the suggested model at two higher education institutions by adopting it and testing it against present higher education functions. Any technical higher education institution seeking excellence in processes can adapt and use the results. The author [30] also demonstrates that there is a substantial gap between the acquisition of abilities like communication and the advancement of completed work. In order to develop many of the necessary industrial skills for a successful job career, it is also evident that the usage of modern tools and knowledge advancement are crucial, and the current curriculum is ineffective at imparting training on these aspects.

III. Research methodology

The main goal of this study was to identify trustworthy quality metrics for engineering education and rank those metrics in accordance with the demands of engineering education customers. To achieve these goals, QFD and fuzzy kano was employed, and engineering education quality parameters were ranked. To get a final ranking of each quality parameter in accordance with the needs of the customer, the QFD method required a number of sequential steps that had to be followed. This involved gathering customer requirements, ranking those requirements according to importance, setting quality parameters, correlating customer requirements and quality parameters, and then calculating scores for each quality parameter.

A survey is undertaken to get the responses of students and faculty members of all over India, on the process and their opinions of quality education parameters. It includes undergraduate, postgraduate, and doctoral students. Also, teachers of some reputed engineering colleges and some others participated in this survey. Questioners were prepared and circulated to students and teachers through Google Forms, and responses were collected. We collected 1250 anonymous responses; students and faculty members were not required to disclose their identities. The questions included in the questionnaire are:

- Are you able to decipher OBE's meaning?
- Do you have the ability to properly write course outcomes that are correlated to programme outcomes or graduate attributes?
- Which method do you employ when creating curriculum?
- What percentage of the course's COs and the entire syllabus is covered by your assessment plan?
- Can action verbs like "understand," "make aware of," and "able to know" be used when writing COs?
- How should COs for your course be written?
- Do you have any knowledge of the cognitive, affective, and psychomotor learning domains?
- Do you have any knowledge of various evaluation/assessment techniques, such as formative and summative assessments, norm- or criterion-referenced testing, anecdotal records, observation techniques, projects, etc.?
- Do you believe that education with a focus on outcomes helps to raise the standard of engineering education in India?

The questions were written so that it would be possible to gauge how well the participants knew the various procedures and concepts associated with high-quality instruction in engineering colleges. It asked questions about how to define quality education, how to frame ranking statements, how to design a curriculum, how to use various teaching techniques, how to use unconventional assessment methods, etc.

Quality function deployment (QFD)[31]

QFD is a tool that focuses on the needs of the customer and offers a way to translate those needs or voices into product specifications. A Mitsubishi engineer named Yoji Akao used QFD as a

system for the first time at the Japanese shipyard Kobe in the 1970s. In many parts of the world, QFD has been used extensively for quality improvement. It is a successful strategy that methodically supports the design team in the creation of new products that meet the needs of the market. Therefore, accuracy in customer requirements input is essential for successfully implementing the HoQ. Toyota has used QFD to reduce their design costs by half and their development time by a third.

Fuzzy Kano model[31]

Customers can choose just one response from the alternatives in a traditional Kano survey, but it ignores any ambivalence in their feelings. In contrast, the Fuzzy Kano survey offers the option for multiple responses by using various Kano categories (Lee and Huang 2009). Customers' opinions of the product are solicited using both functional and dysfunctional questions in both the Traditional Kano model and the Fuzzy Kano model. The Fuzzy Kano model, on the other hand, employs a different mode to enable customers with customized standards to respond to each query. A different response for the same issue is depicted in Figure 1.

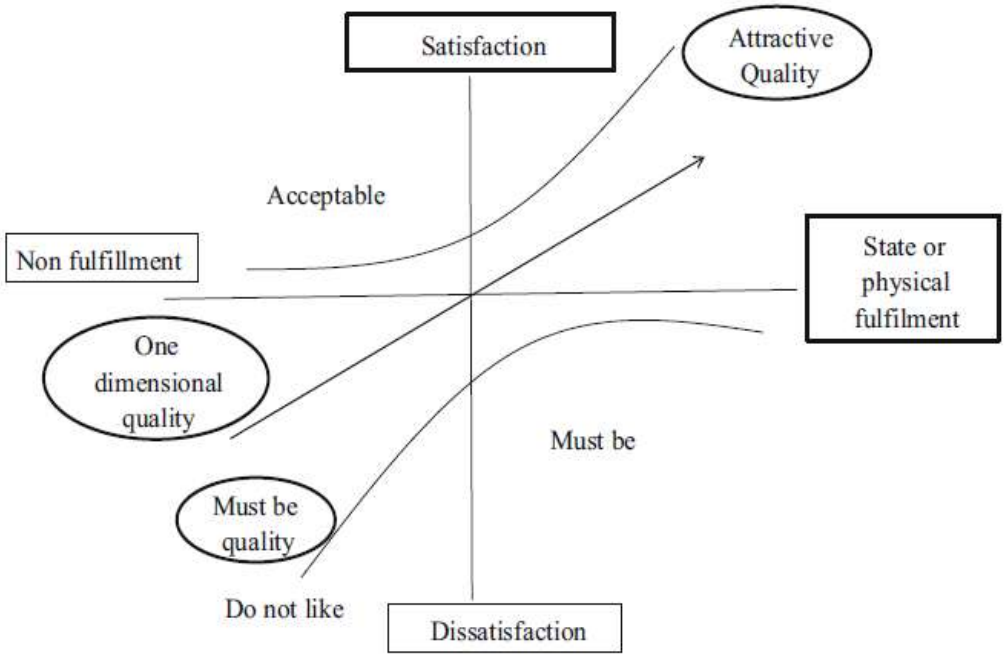

Figure 1 model of fuzzy kano model

IV. Results and discussion

The imperative interpretation of collected data form questioners of OBE of different parameters such as design of courses, understanding of OBE and some others. The total numbers of participations are 1500 all over India. Out of 1500 only 1250 participants responded the questioners and the mapping of interpretation as

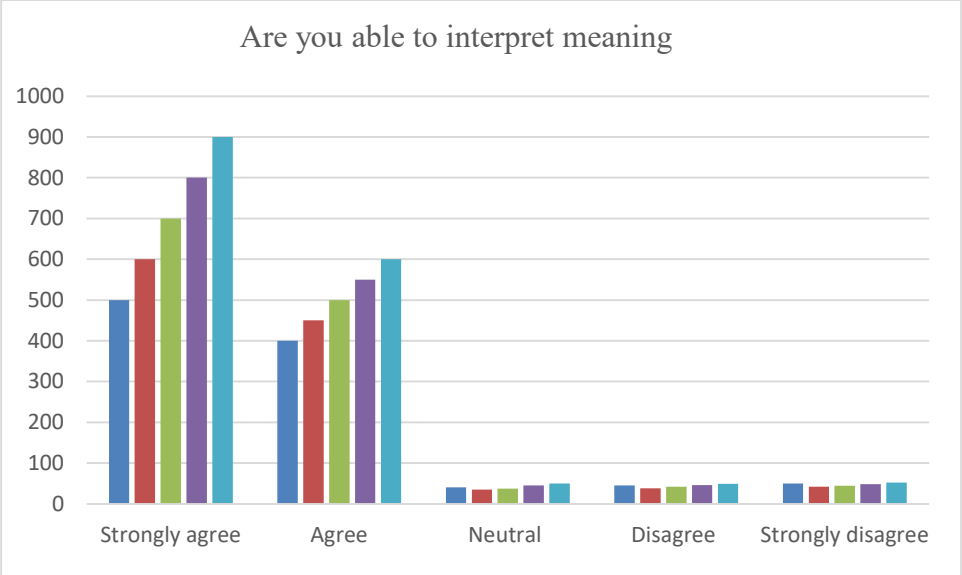

Figure 2 represent the opinion of participants in manners of strongly agree and strongly disagree in between others are agree, neutral and disagree. The maximum number of responders interpret the meaning of OBE.

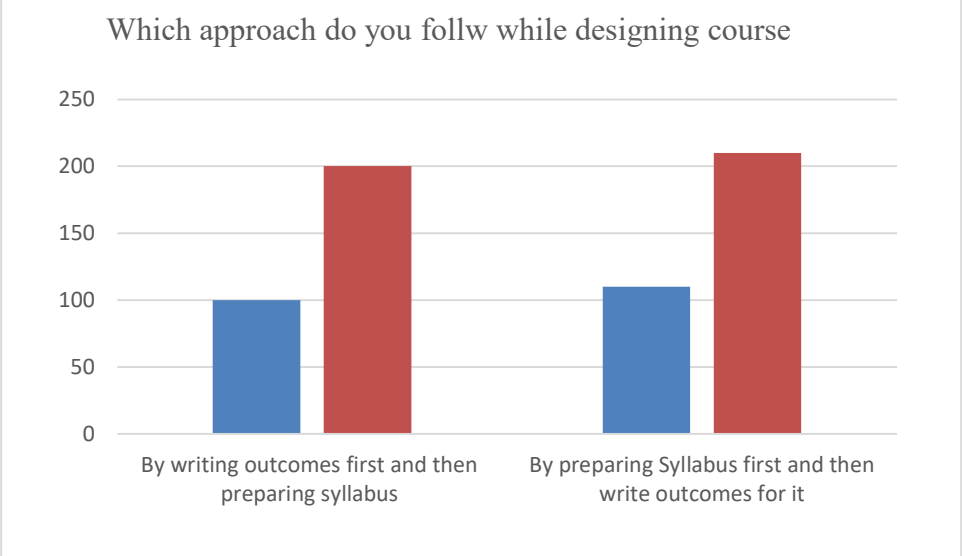

Figure 3 represents the opinion of syllabus design based on outcomes. Some responder writes first outcomes and after that write design of syllabus. However, others are design syllabus first then decide outcomes.

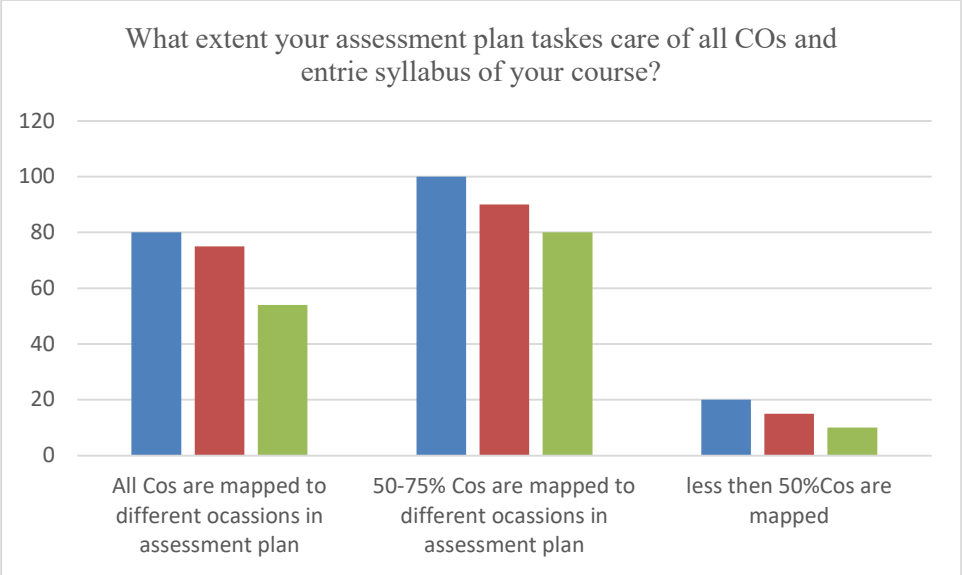

Figure 4 represent the QFD approach for mapping of CO and PO for OBE

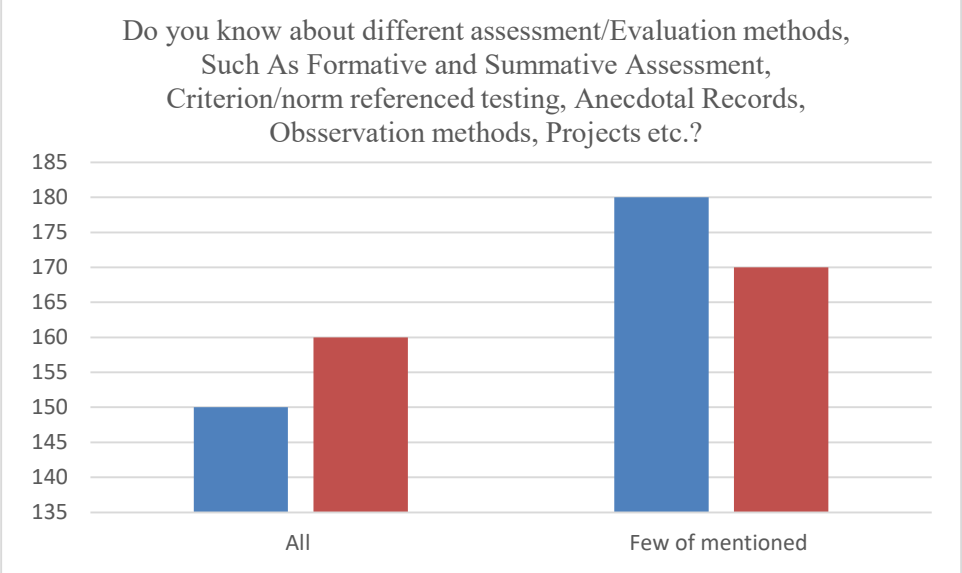

Figure 4 represent the fuzzy kano model approach for others parameters of quality education in engineering colleges.

V. Conclusion & Future Scope

By employing QFD, which focuses on understanding and aligning the expectations of different stakeholders, including students, faculty, industry, and society, the accreditation process can become more holistic and inclusive. QFD enables the identification of key parameters and their prioritisation based on stakeholder requirements, thereby facilitating targeted improvements in the educational system. The integration of the Fuzzy Kano Model further enhances the evaluation process by considering the satisfaction and dissatisfaction levels associated with different parameters. This model enables the classification of parameters into different

categories, such as basic, performance, excitement, and indifference, based on their impact on stakeholder satisfaction. By leveraging the Fuzzy Kano Model, the accreditation process can prioritise areas that have a higher potential for enhancing stakeholder satisfaction and address shortcomings that may lead to dissatisfaction. Implementing QFD and the Fuzzy Kano Model-based approach in the accreditation process can lead to several benefits for engineering institutions in India. It allows for a more evidence-based and data-driven assessment, ensuring that the accreditation process is transparent, objective, and fair. It also encourages continuous improvement by identifying areas for enhancement and allocating resources efficiently. Moreover, the application of these methodologies promotes a student-centric approach by considering student expectations and preferences, leading to improved learning outcomes and the employability of graduates. It also enhances industry relevance by aligning the parameters of accreditation with the demands and expectations of the job market. Overall, the integration of QFD and the Fuzzy Kano Model-based approach in the accreditation process of engineering institutions in India can foster quality enhancement, stakeholder satisfaction, and the overall improvement of engineering education. By embracing these methodologies, engineering institutions can strive for excellence, produce competent graduates, and contribute significantly to the growth and development of the engineering industry in India.

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