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Research Article

Ranking of Performance Assessment Measures at Tehran Hotel by Combining DEMATEL, ANP, and SERVQUAL Models under Fuzzy Condition

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An effective hybrid model has been proposed by combining ANP, SERVQUAL, and DEMATEL techniques. This model aims to meet different purposes of the hotels and diverse needs of customers at different stages, that is, reservation, reception, accommodation, catering, and check-out. High quality services are ensured when customer expectations have been provided at the expectation level of the customers or beyond that. SERVQUAL model is used to assess the performance of the organizations in terms of five dimensions: responsiveness, empathy, reliability, assurance, and tangibles. Super matrix calculations and pair comparisons required in ANP model have been carried out using DEMATEL model in order to measure the influence of performance assessment measures on each other. In this paper, SERVQUAL model parameters have been considered as the expectations of the hotel clients. Then these customer expectations have been analyzed using DEMATEL model and finally have been ranked using ANP model. Parameters of SERVQUAL model are comprised of verbal and vague criteria in terms of the responses provided by the organizations and customers. This has led to fuzzy conditions in this research. The hybrid model provided better results compared with each individual model, in terms of meeting customer satisfaction and the organization's objectives.

1. Introduction

Quality is one of the most important and attractive concepts in management and industrial engineering disciplines that not only has maintained its value but also has gained much more significance due to the increasing competition in the global markets. Due to this fact, nowadays quality is considered as a competitive advantage and also a tool in order to maintain and attract customer satisfaction and profitability [1]. Global competitiveness recently has become the biggest concern for many companies, namely, the companies with continuous improvement to achieve rapid development and to innovate and meet the needs of their clients. Superior performance in services strengthens competitiveness and establishes a relationship with customer, consolidating the brand and communication with the market [2]. Today, business decisions at many companies are directed toward products and services provision to achieve customer satisfaction associated with high levels of profitability [3]. In addition to this, the role is also significant in the development or liquidation of service organizations and, in other words, it is nonnegligible. Customer satisfaction is a vital necessity for the survival of service-providing organizations. Quality enhancement in the hospitality industry can lead to satisfied customers, increase the number of visitors, and positively affect the GDP of countries [4]. In the hospitality industry, the lack of accurate and internationally defined standards has made it difficult to define quality standards for services in this industry, because the quality of service is different significantly from country to country, from city to city, from one hotel to another hotel, from one client to another client, and even from day to day [5]. One of the well-established models for the measurement of service quality and customer satisfaction in the hotel industry is SERVQUAL model. SERVQUAL model has 5 main factors and 22 pairs of questions. To determine needs of customers in this paper SERVQUAL model questionnaire has been used. The importance of each factor has been

measured as a fuzzy five-point Likert scale from customers of three hotels "Parsiani," "Mehr," and "Tehran." To extract the final significance of customer needs and initiatives, the ANP model has been used. To investigate the relationship between these needs and demands with the initiatives adopted by the hotel, QFD model is used. This also has been performed in a five-point Likert scale. To determine the relationship between customer demands and initiatives of the QFD, the team used the average opinion. Next, measures to increase customer satisfaction and improve the organization's objectives have been ranked and prioritized by ANP weights and QFD matrix. In summary, this study has the following three steps.

Step 1. Determine the relevant importance of individual customer needs using Delphi method and SERVQUAL model questions with five fuzzy terms.

Step 2. Rank each and every requirement of hotel customers in order to enhance customer satisfaction and hotel objectives using ANP model and pairwise comparison with a five-point fuzzy range.

Step 3. Determine the relationship between customer requirements and hotel service quality improvement initiatives using Quality Function Deployment and five-point fuzzy scale and ranking them based on the weights obtained from ANP and QFD matrix.

The paper is structured as follows. In Section 2, literature review for five models has been presented: SERVQUAL, ANP, QDF, Fuzzy Logic, and Hybrid models. Identifying and categorizing customer needs (requirements) are performed in Section 3. Section 4 deals with prioritizing the customer needs (requirement) using ANP model. In Section 5 the case study is presented and in Section 6 interrelationships between customer requirements and improvement actions have been determined using QFD model. Section 7 is devoted to service quality improvement actions in order to meet prioritized customer needs and Section 8 is the results and future research.

2. Literature Review

Nowadays, customer satisfaction is known as one of the most common terms in business contexts but, no doubt, creating customer satisfaction and getting them excited by quality goods and services requires, in the first place, identifying their needs and requirements and then transforming these needs into technical specifications. Due to increasing complexity of economic, social, and cultural systems, these will not happen by themselves and methods and systematic events are required in order to transform these concepts to organizational processes. Under these circumstances, on one hand, customer satisfaction is essential in all aspects of the services and, on the other hand, service-providing organizations must obtain the defined goals while ensuring employees support and meeting the established constraints. In this paper, literature review is composed of five sections:

(1) SERVQUAL model (recognizing and classification of customer needs)

(2) ANP model (prioritizing customer needs in order to enhance customer satisfaction)

(3) QFD model (determining the relationships between customer needs and organizational initiatives using ANP weights)

(4) Fuzzy logic (converting customers imprecise language to fuzzy numbers for the calculations)

(5) Hybrid models (examining various combinations of the above-mentioned models in different industry and service sectors).

In studies conducted so far, a combination of ANP and SERVQUAL models (deterministic and fuzzy) and a combination of QFD, ANP, and SERVQUAL models have not been used simultaneously for the improvement of organizational initiatives in order to obtain organizational objectives and customer satisfaction simultaneously.

2.1. SERVQUAL Model. Study of the recent developments represents a vast expansion of services and suggests the ever increasing speed of this trend in the years to come. In other words, industry has undergone downsizing and service sector is growing [6]. Quality of services is critical to the success of any service-providing organization [7]. Customers, whether consumer or service provider, have a huge impact on different aspects of their organizations. In the literature, proper measurement of service quality is guided toward the definitions of quality, training more [8], the service quality dimensions [9, 10], significance of service quality [11], and customer satisfaction [5]. SERVQUAL model introduced in 1985 is one of the most well-known methods for measuring the quality of services [12]. Parasuraman et al. in their study concluded that by comparing customer service performance they were able to understand what customers think about needs and requirements and it allows them to assess the quality of service. If you lower the level of customer service performance, expectations gap will occur. SERVQUAL model is used to measure customer satisfaction and customer satisfaction calculation of the gap (the gap between customer expectations and organizational performance). SERVQUAL model initially had 10 questions and 97 pairs after the couple has been questioned. In order to alleviate this model, supplementary investigation was carried out after the final model in question is summarized in five and 22 pairs [13]. Five main aspects that have an impact on customer evaluation of service quality are defined as follows [14]:

(1) *Tangibles* include physical facilities, tools, and equipment and other tangible models of communication used to provide the service.

(2) *Credibility* includes factors such as trustworthiness, believability, and honesty in providing service for customers.

(3) *Responsiveness* is the readiness and willingness of employees to help customers by providing prompt timely services.

(4) *Courtesy* is the consideration for the customer's property and a clean and neat appearance of contact personnel, manifesting as politeness, respect, and friendliness.

(5) *Knowing the customer* means making an effort to understand the customer's individual needs, providing individualized attention, recognizing the customer when they arrive, and so on.

These aspects have remained unchanged up to this day. This reference framework has been used in almost every research with the objective of measuring and managing service quality by deploying a questionnaire that measures both the customer expectations of service quality in terms of these five dimensions and their perceptions of the service they receive. Parasuraman et al. have asked customers several times to score the organizations in order to determine the validity of the questionnaire. For the internal reliability test, correlation analysis using Alpha Cronbach has been performed. The obtained results are desirable and led to popularity of the model [15].

Five dimensions of service quality are examined with 22-pair questions in SERVQUAL questionnaire. The first question deals with customer waiting and the second question deals with customer perception based on five-point fuzzy Likert [16]. According to the collected data obtained from questionnaires and their analysis, the resulting gap analysis, resulting in a gap between what customers want and what they offer, will be calculated. In order to examine the specific characteristics of different industries and services, this model can be extended to other sectors also added to the questionnaire [17]. To calculate the deficit or gap between each dimension of service quality and customer expectations the following formula is used:

$$O_j = \frac{\sum_{i=1}^{n} \left(P_{ij} - E_{ij}\right)}{n_j}. \tag{1}$$

j is SERVQUAL model dimensions, n_j is number of questions in j dimension, P_{ij} is average of perceptions, E_{ij} is average of expectations, and O_j is gap between every dimension.

If O_j is positive, the level of service quality is higher in relation to customer expectations in terms of j dimension; otherwise, the level of service quality is lower in relation to customer expectations in terms of j dimension. In short, however negative the value is; it suggests that the higher the improvement priority must be assigned for the corresponding dimension. In this paper, SERVQUAL model was used to identify and classify the needs and demands of customers.

2.2. The ANP Model. The world around us is full of multi-criteria problems and people mainly make decisions under such conditions. Some of these decisions are so important that any error may impose irreparable losses on us. It is therefore necessary to develop appropriate techniques for selecting optimal techniques and correct decisions. Analysis Network Process (ANP) is one of the most complete of these techniques, first developed by Saaty [18] in 1980. This process is one of the most comprehensive systems designed for multiple attribute decision-making, because this technique provides the possibility of formulating the question in the form of a network and also taking into account qualitative and quantitative criteria at issue. This process is involved in decision-making options and the criteria and subcriteria sensitivity analysis when possible. In addition, pair-wise comparison is based on the judgment and facilitates calculations. It shows the compatibility or incompatibility of the decision. In addition, it has a strong theoretical basis and is based on the principles of being self-evident. Analytic Network Process is a graphical representation of a real complex problem and headed by general purpose next level criteria, subcriteria, and their options. In this article, access to quality services at the top of the charts as the ideal objective is examined. In the next levels five dimensions of SERVQUAL model as service quality improvement criteria and SERVQUAL questions as alternatives have been used. Network analysis process diagram is illustrated in Figure 3.

2.3. QFD Model. To meet the demands of customers in each of the services provided to them, technical and practical measures turned out to be one of the most powerful tools to transform customer needs into technical specifications and practical measures; the QFD method is a method in which organizations have to focus more on your various units in order to achieve the characteristics of the customer of the goods or services utilize [19]. The philosophy of this approach is applied and the quality demands of customers in different development stages of a product service or project are defined. This technique as one of the modern methods of management and engineering quality, market study, and identifying customers began to work and the process of investigation and analysis in addition to identifying the needs and requirements of customers tries to incorporate these expectations at all stages, including design, production, and support [20]. QFD model determines the relationship between parameters such as consumer needs and requirements of engineering a comparative analysis from customer conception of other products, services, and similar projects to establish [21]. QFD model is based on identifying implicit and explicit needs of customers and translating them into the service specifications and reflecting them in all units of the organization. Also, the QFD tool that enables the product development team to identify potential conflicts in the process of identifying and translating the demands of customers into technical requirements, reduced as much as possible. Some of these conflicts include nonconformity of technical product requirements with the demands and needs of our customers, as well as nonconformity of the final product with technical product requirements mentioned. To reduce these conflicts, technical product requirements have to consider the customer needs and demands [3]. The QFD model is applied in various services and industries including education, healthcare, and service sector and helps to understand customer needs and requirements and to turn them into technical specifications, but prioritizing the demands of customers always requiring technical

$$\mu_A(X) = \begin{cases} \dfrac{X - a_1}{a_2 - a_1}, & a_1 \le X \le a \\ \dfrac{X - a_3}{a_2 - a_3}, & a_2 \le X \le a \\ 0 & \text{O.W} \end{cases}$$

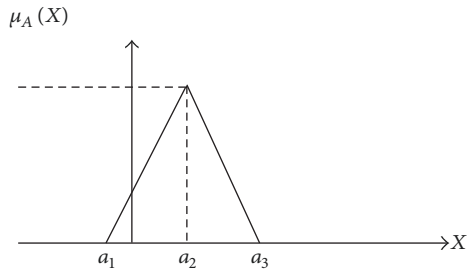

Figure 1: Set of fuzzy numbers and terms.

assistance in this model has been questioned [22], which was used in this article to answer the question of ANP model.

2.4. Fuzzy Logic. The history of criticism of the thought of the world being zero and one, black and white, and right and wrong dates back to more than fifty years ago. Although the exact sciences have been able to correctly explain many phenomena and classical logic has brought the right conclusions, they have not been able to model and explain everything that is all around us. Fuzzy Logic was presented by Dr. Lotfi Zadeh in 1965 at the University of California, Berkeley. He presented human logic into mathematics. If we consider black and white to be corresponding to zero and one in mathematics, the mathematical logic does not recognize the color spectrum existing between these two colors. But in fuzzy sets, there is a spectrum of grey colors and that is where human and machine intersect. The main advantage of fuzzy logic lies in the expression of vague or partially true variables or values. The application of fuzzy logic is widely diverse due to multiple characteristics of it. Also this concept plays an important role in decision-making sciences. Generally, characteristics of fuzzy logic have turned it into a much more efficient tool in quality subjects compared to other conventional mathematic tools. Prioritizing customer needs and quality improvement initiatives are also considered as quality and human fields of science in which various qualities and mathematical and engineering tools are used. So, employing fuzzy logic makes these tools more intelligent and brings them closer to human reasoning [23]. Linguistic variables related to the degree of satisfaction and importance are often ambiguous and vague in nature. For example, expression of satisfaction in terms of "Very Satisfactory," "Somewhat Satisfactory," and "Not Satisfactory" is often seen as a natural perception of customer priorities and judgments. The applicability of fuzzy theory in decision-making sciences lies in the ambiguity and vagueness of expression. When available information is subjective and inaccurate, fuzzy modeling is an effective way to formulate decision-making problems [24]. Herreva and Viedma emphasized that, in situations with subjective decision-making and uncertainty, linguistic variables are an effective tool for better and easier understanding and evaluation of the service quality performance [25].

Fuzzy number is an effective method in order to sufficiently entail subjective and objective knowledge and understanding. Lotfi Zadeh in 1975 developed fuzzy logic, introduced approximate reasoning concept, and showed that logical and vague statements comprise algorithms that help us to use ambiguous data to achieve optimal results [26]. In this study, the triangular fuzzy numbers have been used according to Figure 1.

A crisp of a triangular fuzzy number is obtained from the following equation:

$$A_a = \left[a_1^a, a_2^a\right] = \left[\left(a_2 - a_1\right)a - \left(a_3 - a_2\right)a + a_3\right] \qquad 0 \le a \le 1. \tag{2}$$

Every fuzzy term is represented by a triangular number in the range $(1, 0)$. The fuzzy numbers used in this research are provided in Table 3. In every management science research, respondents may have a different understanding and perception of the linguistic terms. Fortunately, these errors are of minor importance, because the default values (Table 3) have been used as representative values to reflect the priorities and the membership function of Figure 1; the formula explains the asymmetry of the fuzzy numbers by the asymmetry of the linguistic terms.

2.5. Hybrid Models Literature Review. Although SERVQUAL, QFD, and Fuzzy ANP techniques have been applied individually in service and industrial research settings, hybrid application of these three techniques under fuzzy conditions has not been seen so far. Some of the recent researches using SERVQUAL, QFD, and Fuzzy ANP techniques with fuzzy approach single or double or triple models are as follows.

Aysun and Masoudi proposed a hybrid QFD and SERVQUAL conceptual framework to measure the hotel service quality using the SERVQUAL model as a starting point and then identified service design and hotel guests' requirements using a QFD approach. In this research a six-step model has been proposed to improve the service quality in hotel industry [27].

Benítez et al. measured the service quality in hospitality industry using fuzzy numbers. In their research, they determined the priority of improvement initiatives using TOPSIS method [28].

Kazemi & Almardani developed a SERVQUAL based model prioritizing quality improvement measures in Chalous Province Power Distribution Office. They proposed effective initiatives for the improvement of each of the five service quality areas using statistical studies and analysis [29].

In the study, published in 2005 in the International Journal of Intelligent and Fuzzy Systems, which was titled "Implementation of QFD Based on ANP Process of Linguistic Data: An Application in the Automotive Industry," researchers intended to use QFD techniques in a fuzzy environment with the demands and needs of our customers, to prioritize design requirements by examining the correlation between customer needs, design requirements, and interdependence among them; the ANP have used these techniques [1].

In a research, titled "A Fuzzy Optimization Model for QFD Planning Process Using ANP Method" whose results were published in the International Journal of Operational Research in 2004, using quality function deployment (QFD) the authors tried to reduce the conflicts due to lack of conformity between customers' requirements and product characteristics and also lack of conformity between technical specifications and final product and, then, the correlations between customer requirements and technical specifications have been examined using AHP method and, due to imprecise and ambiguous data, linguistic parameters have been addressed in ANP. Due to imprecise and ambiguous data and lack of quantitative tools, a mixed integer linear programming model has been developed in order to meet technical specifications of the product and, finally, technical indices have been prioritized using a fuzzy ranking method [3].

In the research titled "Using QFD and ANP to Analyze the Environmental Production Requirements in Linguistic Preferences" published in the International Journal of Expert Systems with Applications in 2010, authors, at first, tried to facilitate the main issue of the QFD problem; however, the "What" questions of EPRs and "How" problems of the SPIs have to be made, which are two major components and they should be emphasized on the house of quality matrices. In conjunction with fuzzy sets theory and analytical network process, the systematic analytical procedures are proposed. Subsequently, the systematic network processes have been proposed using a combination of fuzzy sets and ANP method and, ultimately, the precise awareness of the SPI and focus on using ERP effects for the case company have been suggested [30].

In a paper titled "Rapid Tooling Route Selection for Metal Casting Using QFD–ANP Methodology," published in International Journal of Computer Integrated Manufacturing in 2007, the author has proposed an integrated methodology using QFD and ANP methods to determine and prioritize the technical and engineering requirements of casting parts, based on the customer needs, for selection and evaluation of an appropriate rapid prototyping- (RP-) based route for tooling fabrication. Ultimately, the author developed a planning matrix using a robust evaluation method based on ANP in order to translate customer needs to technical requirements [22].

In an article titled "A Model with a Customer-Manufacturer-Competitor Orientations for Life Cycle Analysis of Products Based on QFD, AHP/ANP, and TRIZ" published in 2007 in the Journal of Design Engineering, the researchers proposed a customer-manufacturer-competitor model to help manufacturers to analyze customers, suppliers, and competitors orientations and the issues related to PLC. This model is composed of three evaluation processes: (1) customer-oriented evaluation, (2) manufacturer-oriented evaluation, and (3) ideal formulation [31].

In an article titled "An Effective Decision Making Approach Using a Combination of QFD and ANP" published in 2008 in the WSEAS Transactions on Business and Economics Journal, researchers developed an effective decision-making approach based on QFD and ANP approaches in order to help decision-making in planning or evaluation problems using a practical example [32].

Atashsooz in 1383 in his master thesis in the field of industrial management in Tehran University titled as "Designing a Product Planning Model Using QFD, ANP and Goal Programming" suggests that in order to develop the houses of quality first it is required to examine the relationships between customer needs and product specifications regarding the interrelationships between customer needs and product specifications in order to be able to prioritize product specifications in house of quality. The research has exploited the analytical network process (ANP) for this purpose. Moreover, the proposed decision-making algorithm considers the multiobjective nature of the problem and includes other objectives related to the product design and development including the constraints related to human resource and product specification scalability and design. The researcher proposes a Zero-One Goal Programming model that incorporates the relative importance of the product technical specifications determined using ANP approach and, according to the obtained results, suggestions for design and development of the software in order to increase the customer satisfaction have been provided [33].

Zaheri, in a master's thesis in the field of industrial engineering at the University of Yazd titled "Prioritizing Strategic Actions at Strategic-Oriented Organizations by Combining AHP and QFD with Fuzzy Variable," in this line of research by identifying customer demands at Telecom Fars Province, tried to prioritize these demands using the AHP, TOPSIS, and AHP-LP techniques, determining strategic actions that eventually led to the realization of customers' demands, transforming the relationship between customer demands and strategic actions into the form of fuzzy numbers at fuzzy QFD house of quality. Ultimately, strategic actions have been carried out. The results of prioritizing strategic actions have been compared with the results of TOPSIS and AHP-LP [34].

3. Identifying and Classifying the Customer Needs

For information gathering in order to identify and classify customer needs and demands in the hospitality industry,

Table 1: Fuzzy representation of numbers and scales.

Symbol	Scale	Weight	Verbal expression	Verbal expression
V	Excellent	(0.75, 1, 1)	Extremely important	Very high
H	Good	(0.5, 0.75, 1)	Very important	High
M	Fair	(0.25, 0.5, 0.75)	Important	Average
L	Poor	(0, 0.25, 0.5)	Relatively important	Low
P	Very poor	(0, 0, 0.25)	Unimportant	Very low

Table 2: Service quality improvement indices.

Index code	Factors	Class
T_1	(i) The attractiveness of the location, facade design, and outdoor surrounding	Tangibles
T_2	(ii) Appealing and diversity of interior decoration	
T_3	(iii) Cleanliness, uniformity, and appearance of staff	
T_4	(iv) Modern entertainment and recreation facilities	
T_5	(v) The hotel's interior and exterior are clean	
L_1	(i) Orders done by staff properly and on time	Reliability
L_2	(ii) Cleanness and quality of rooms	
L_3	(iii) Facilities of rooms (equipment worked properly)	
S_1	(i) Proper welcoming of customers by employees at the front desk and reception	Responsiveness
S_2	(ii) Employees responded promptly to my requests	
S_3	(iii) Employees responded quickly to my problems (speed of service)	
S_4	(iv) Reservation and service cover area	
A_1	(i) Staff experience and professionalism in providing error-free services	Assurance
A_2	(ii) Staff politeness	
A_3	(iii) I got what I paid for	
A_4	(iv) Effort done by staff for security and comfort	
A_5	(v) Hotel atmosphere (calm and quiet)	
E_1	(i) Hotel prevision for customer necessities	Empathy
E_2	(ii) Staff availability	
E_3	(iii) I received undivided attention at the front desk	
E_4	(iv) Staff flexibility in order to receive and respond guest requests	
E_5	(v) Provision of special services for children, people with disabilities, and the elderly	

Table 3: Priority of SERVQUAL model index.

Dimension (1)	Dimension (2)	Dimension (3)	Dimension (4)	Dimension (5)
(0.2, 0.3, 0.35)	(0.7, 0.75, 0.8)	(0.3, 0.35, 0.45)	(0.5, 0.6, 0.7)	(0.4, 0.45, 0.5)
(0.4, 0.5, 0.67)	(0.8, 0.95, 1)	(0.25, 0.35, 0.4)	(0.4, 0.5, 0.55)	(0.15, 0.2, 0.25)
(0.7, 0.75, 0.95)	(0.65, 0.75, 0.85)	(0.5, 0.65, 0.7)	(0.75, 0.85, 0.95)	(0.2, 0.25, 0.35)
(0.4, 0.45, 0.5)		(0.6, 0.7, 0.8)	(0.7, 0.8, 0.9)	(0.35, 0.5, 0.74)
(0.75, 0.8, 0.85)			(0.7, 0.8, 0.85)	(0.6, 0.8, 0.9)

in field studies, the model SERVQUAL has been the most widely used. Accordingly, in this study, five dimensions and 22 pairs of questions in SERVQUAL model have been used. Based on interviews with experts and executives in the hospitality industry, 22 coupled questions in five dimensions of service quality, SERVQUAL model, have been selected and included in the questionnaire. To get customer feedback on the effectiveness of each of the major and minor criteria in assessing the quality of hotel services, a questionnaire was designed. The questionnaire includes a table comparing the main criteria and subcriteria of the five dimensions of SERVQUAL model. The criteria and measures are provided in Table 2. In these tables, the importance of each criterion from the customer perspective, with fuzzy scales of very low, low, medium, high, and very high, has been questioned. Out of 125 questionnaires distributed, 107 questionnaires have been completed. The corresponding fuzzy numbers are provided in Table 1 and Figure 2 [35]. Average importance of the survey is shown in Table 2.

4. Prioritizing Customer Needs Using ANP

In order to calculate the importance of each customer's needs in this study, questionnaire approach and fuzzy ANP have

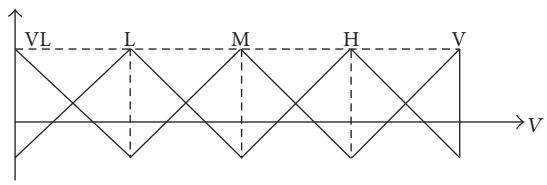

Figure 2: View fuzzy numbers and options.

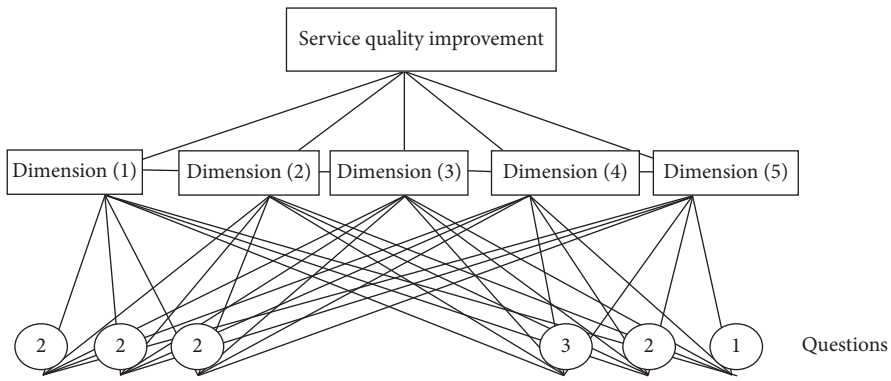

Figure 3: ANP diagram.

been used in combination. Also in order to convert the weights obtained from every customer questionnaire to pair-wise comparison of each individual customer questionnaire, every individual item in the questionnaire is divided by each other (W_j/W_i) and are compared to each other at every row and, finally, pair-wise comparison matrix is obtained based on the preferences. If the matrix of the weight of main dimensions of service quality is W_1 and the matrix of correlation among main options is W_3, then prioritizing of the main options of service quality regarding the internal correlation among these main service quality dimensions is the multiplication of two matrices $W_F = W_3 * W_1$. Also, whether the matrix of the weighted vectors of dimensions required strengthening the main dimensions of service quality is represented as W_2 and the internal correlation between dimensions is represented as W_4; then, priority of the quality improvement options is the multiplication of $W_P = W_F * W_R$. The final weight of each of the dimensions and options to improve are presented in Table 3. ANP model diagram is shown in Figure 3.

In this model, each dimension of service quality as compared to the overall goal of a whole-choice test (equal importance, a little more, more, much more, and more great) was assessed. As well as any of the SEVQUAL model questions, the five aspects of model-choice test have been questioned. In this model, internal cohesion and solidarity between the qualities of internal questions of SERVQUAL model for paired comparisons have been conducted in the same range of five options.

5. Identification and Classification of Quality Improvement Measures

After the identification, classification, and prioritization of needs and demands of customers QFD team has to identify measures to improve service quality and increase customer satisfaction. The number of these measures in reviewed literature [23, 27, 29] and others has been collected and categorized by QFD team. In short, this procedure is categorized in Table 4.

6. Determining the Relationship between Customer Demands and Measures to Help Improve the Quality of QFD

In this step, the intensity and quality of relationship between each customer need and requirements and each hotel service quality improvement initiative are determined. The relationship between customer demands and improvement initiatives adopted by hotel could be represented by numbers or contract signs. To do so, in this paper fuzzy terms of "*very high,*" "*high,*" "*medium,*" "*little,*" and "*very little*" are used. QFD team has used brainstorming method to identify this relationship. In this paper, every relationship is individually discussed by QFD team and then one of the fuzzy terms is chosen for that relationship. The relationships between customer needs and requirements and hotel initiatives at QFD house of quality matrix are shown in Table 5.

Table 4: Service quality improvement initiatives.

Action code	Initiatives	Class
P_1	(i) Automation	Acceptance and settlement system P
P_2	(ii) Reservation radius	
P_3	(iii) Room delivery & settlement	
K_1	(i) Proper and on-time order	Cleaning and service K
K_2	(ii) Help to carry luggage	
K_3	(iii) Room and hotel environment cleanliness	
F_1	(i) Quality, quantity, and diversity	Food and beverage F
F_2	(ii) Sanitation and health	
F_3	(iii) Service waiting time and cost	
U_1	(i) Belongings and documents	Hotel security U
U_2	(ii) Goods and items	
U_3	(iii) Spouse and children	
O_1	(i) Facilities and equipment	Hotel facilities O
O_2	(ii) Room size and hotel places	
O_3	(iii) Silence	
O_4	(iv) Service waiting time and cost	
O_5	(v) Hotel view and lighting	
M_1	(i) Staff politeness and courtesy	Hotel staff M
M_2	(ii) Staff education and training	
M_3	(iii) Team work	
M_4	(iv) Hotel staff uniformity and cleanness	
Q_1	(i) Diversity and attractiveness	Hotel recreational facilities Q
Q_2	(ii) Special services	
Q_3	(iii) Modernity	

7. Prioritize Actions to Help Improve the Quality of QFD

In this section, using QFD rules and the obtained results, quality improvement initiatives have been ranked. For this purpose, consider a column to the right of the QFD table. This column contains the priority of customer needs and is represented as a fuzzy number. If fuzzy numbers of this column are multiplied by the fuzzy numbers column p_i and then added together and divided by 22, the weight is achieved. This operation is similarly performed for other columns. The results of this operation are shown in the weight column of Table 6.

7.1. Ranking Quality Improvement Initiatives with Fuzzy Logic. For triangular fuzzy numbers $A_i = (L_i, M_i, U_i)$ ranking is based on the following three criteria [23, 26, 36].

(1) The calculation of the enclosed surface area: $S_i = (L_i + 2M_i + U_i)/4$

(2) Mode: $\text{Mode}(A_i) = M_i$

(3) The scope of fuzzy number: $R(A_i) = U_i - L_i$.

The three criteria are applied in a sequential order. This means that if, after calculating the first criterion, the number of conditions are equal, then the second initiative is applied and then again in the third criterion it is used equally. The results of the ranking are provided in Table 6. For ranking of these measures, only the first criterion is used and there is no need to apply the rest of the criteria.

This ranking reflects the results below.

The first priority of the hotels in order to meet customer satisfaction is the cost and time of stay and hospitality. Room cleanness and hotel environment come second. The third priority is the quality, quantity, and variety of food and beverages. The fourth priority is the courtesy and politeness of the hotel staff. The fifth priority is special customer service of the hotel. The remaining priorities for the satisfaction of hotel customers are provided in Table 6.

8. Discussion

Today, good service is one of the basic concerns of all service organizations, including the hotel industry, and many hotels have been carefully monitored by these indicators to increase customer satisfaction, especially in this type of industry. They use personalization as an attempt to increase customer satisfaction, in order to increase profits in raising quality assurance. In fact, you need to be sure that they provide the right product or service to the right person. In this research, the effectiveness of the combined model and its impact are investigated through the combination of the stated techniques, to meet the multiple objectives of the hotel and the various needs of customers in different stages. Customer loyalty is guaranteed when the customer's expectations of the service are provided and, on the other

Table 5: QFD house of quality.

Customer requirements	Hotel initiatives																							
	P			K			F			U			O					M				Q		
	P_1	P_2	P_3	K_1	K_2	K_3	F_1	F_2	F_3	U_1	U_2	U_3	O_1	O_2	O_3	O_4	O_5	M_1	M_2	M_3	M_4	M_1	M_2	M_3
T																								
T_1	P	P	P	P	P	P	P	P	M	P	P	M	M	M	M	M	H	P	P	P	H	H	H	M
T_2	M	M	P	M	P	H	M	M	H	M	M	P	H	M	H	H	M	L	P	P	M	V	H	H
T_3	P	P	L	H	M	H	V	V	V	M	L	M	H	P	M	V	M	M	M	M	V	H	M	M
T_4	H	H	M	M	M	M	M	M	M	M	M	M	H	P	M	H	M	P	P	M	P	H	H	H
T_5	P	P	P	M	M	H	H	H	V	M	V	H	M	M	P	M	H	P	P	M	V	H	M	H
L																								
L_1	H	H	V	H	H	M	H	H	V	H	H	H	M	M	L	H	P	M	M	H	L	P	H	M
L_2	P	P	P	P	P	V	H	H	V	L	L	L	L	P	P	H	L	M	M	M	V	P	L	L
L_3	L	P	P	H	H	M	M	M	H	H	H	H	V	L	L	V	H	P	P	L	M	H	H	V
S																								
S_1	P	P	M	M	M	M	M	M	M	L	L	L	L	L	L	M	P	H	H	P	M	P	M	P
S_2	P	P	M	M	M	H	M	H	H	L	L	P	M	P	P	H	L	H	M	L	L	P	M	P
S_3	V	V	V	H	M	P	M	P	V	H	H	H	H	P	P	V	L	L	P	P	L	M	V	V
S_4	V	V	V	H	M	H	H	M	H	H	H	M	M	P	P	M	P	M	P	M	L	P	M	M
A																								
A_1	H	H	V	H	M	M	V	V	V	M	M	M	M	L	M	H	L	H	M	M	H	M	M	M
A_2	P	P	M	M	H	H	H	H	V	M	M	M	P	P	P	M	P	V	H	M	H	M	M	M
A_3	M	H	H	V	H	H	V	H	V	M	M	M	M	V	M	V	M	M	M	M	H	H	V	H
A_4	P	M	L	M	H	V	H	H	V	H	H	H	L	P	V	H	P	H	M	L	H	P	M	L
A_5	P	P	P	P	P	P	P	P	H	V	V	V	L	P	V	H	L	P	P	P	L	P	M	M
E																								
E_1	L	M	H	H	H	H	H	H	H	L	L	L	M	P	P	L	P	M	L	L	M	P	M	L
E_2	H	L	H	V	H	M	L	L	H	P	P	L	L	L	P	M	P	M	M	L	P	P	M	L
E_3	H	L	M	M	L	L	L	L	L	P	P	P	L	P	P	M	P	M	L	L	L	P	H	H
E_4	L	P	M	L	M	M	M	M	H	M	M	M	L	P	P	M	P	M	M	P	L	M	M	L
E_5	M	V	M	H	H	H	H	H	V	H	H	H	H	M	L	V	L	M	M	M	H	V	V	V

hand, through the quality of service. SERVQUAL model for assessing hotel performance and comparing the ANP model needed by DEMATEL model is used to measure the effect of performance evaluation indicators on each other in a hybrid model and then ranked by the ANP model. The results of the implementation of this hybrid model indicate better solutions to the implementation of each of the above models in providing customer satisfaction and organizational goals simultaneously.

9. Conclusions and Future Research

In this study, a hybrid model SERVQUAL + QFD + ANP has been proposed and used to prioritize quality improvement initiatives at international hotels in fuzzy terms to satisfy the customer's needs and requirements.

SERVQUAL model has been applied to identify and classify the needs of customers, ANP model for careful prioritization of needs and demands of customers, and QFD house of quality in order to ensure the relationship between customer needs and demands and hotel service quality initiatives and prioritizing the service quality improvement initiatives. This hybrid model allows us to prioritize and rank the quality improvement initiatives focused and oriented toward performance enhancement and increasing the customer satisfaction. The extended form of this model could be used as a powerful tool that enables the hotel managers not only to increase customer satisfaction but also to reduce hotel costs in the long term. The results of the hybrid model while confirming the results of the previous studies and in a joint meeting with hotel managers and QFD team provide us with better results compared to individual and separate application of ANP, QFD, and SERVQUAL models which results in greater customer satisfaction and more effective organizational performance. The results of the SERVQUAL model could be used as input for QFD and prioritized needs and demands of customers using ANP model could be used as supplement for QFD model.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Table 6: Ranking of service quality improvement initiatives.

Initiative	Weight of initiative	Enclosed surface area	First rank
P			
P_1	(0.101705, 0.20625, 0.391364)	0.226392	19
P_2	(0.128409, 0.232955, 0.406818)	0.250284	18
P_3	(0.136364, 0.264205, 0.440227)	0.27625	15
K			
K_1	(0.182955, 0.338636, 0.537386)	0.349403	7
K_2	(0.155682, 0.302273, 0.507273)	0.316875	12
K_3	(0.196023, 0.358523, 0.560795)	0.468466	2
F			
F_1	(0.211364, 0.381818, 0.57875)	0.388438	3
F_2	(0.193182, 0.353409, 0.558295)	0.354574	7
F_3	(0.307955, 0.511364, 0.659545)	0.497557	1
U			
U_1	(0.157386, 0.324432, 0.529318)	0.333892	9
U_2	(0.140909, 0.306818, 0.508864)	0.315852	13
U_3	(0.156818, 0.319318, 0.520909)	0.329091	10
O			
O_1	(0.128409, 0.294318, 0.499545)	0.304148	14
O_2	(0.055682, 0.131818, 0.309659)	0.157244	24
O_3	(0.085795, 0.186932, 0.365568)	0.206307	22
O_4	(0.24375, 0.436932, 0.621591)	0.434801	4
O_5	(0.061932, 0.168182, 0.361932)	0.190057	23
M			
M_1	(0.113068, 0.248295, 0.452955)	0.375653	5
M_2	(0.078409, 0.185795, 0.386818)	0.209205	21
M_3	(0.078409, 0.202841, 0.398409)	0.220625	20
M_4	(0.168182, 0.336932, 0.523182)	0.341307	8
Q			
Q_1	(0.132386, 0.243182, 0.436932)	0.26392	16
Q_2	(0.186932, 0.372159, 0.569318)	0.365142	6
Q_3	(0.157386, 0.323295, 0.5075)	0.327869	11

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