

# QUALITY FUNCTION DEPLOYMENT (QFD) AND KANO ANALYSIS FOR IMPROVING HOSPITAL SERVICE QUALITY

<sup>1</sup>PROF. DR.T.JEYARAJASEKAR, <sup>2</sup>IRENE ANN ISSAC

<sup>1</sup>Principal, <sup>2</sup>Second year MHA Student  
College of Hospital Administration  
Dr.Somervell CSI Memorial Medical College and Hospital

**Abstract:** One of the primary concerns of hospital executives is their capacity to improve the performance of their organizations. Managers can attain this aim by employing quality management and decision-making approaches. The corrective activities to improve hospital service quality are determined and selected in this study utilizing a combination of the quality function deployment (QFD) approach, kano analysis and the Knapsack Problem Mathematical Model (KPMM). This method is used in Pandian Heart Center, Madurai, Tamilnadu, India. First, the needs of the clients are determined. The corrective acts that will satisfy these desires are then identified, and the link between each corrective activity and each want is established. Following that, based on the kano analysis, the sorts of desires are recognized, as well as their weights. This research identified 30 client desires, with "Professional and experienced physicians and nurses" and "Healthy and adequate consumables" receiving the most votes. There are two "attractive" consumer desires, 15 "onedimensional" customer wants, and 13 "must-be" customer wants, according to the findings. Finally, 30 remedial tasks have been identified and are being implemented in the quality house. The remedial efforts "Training of physicians and nurses" and "Increasing staff sense of responsibility" received the most votes. In the house of quality approach, using the kano analysis to determine the weight of customers' needs causes the organization's plans to be taken into consideration while prioritizing corrective efforts. Furthermore, KPMM allows for the best possible selection of remedial activities. Hospital, House of Quality, Kano Analysis, Functional Expansion.

**Keywords:** House of Quality, Kano Analysis, Quality function deployment (QFD), Knapsack Problem Mathematical Model (KPMM).

Healthcare is a critical problem in any culture, and it has grown in importance in recent years as living standards have risen and the need for improved healthcare to improve quality of life has been apparent (Torkzad A & Beheshtinia MA et al. 2019). Several research projects on the subject of healthcare performance assessment (Hatefi SM; Haeri A et al 2019) optimization and quality enhancement have been created in recent years. Hospitals should not only provide medical care but also handle consumer satisfaction concerns. Consumer satisfaction is achieved through improving healthcare services based on customer needs.

Quality function deployment (QFD), Kano's model, multi-criteria decision making, and other customer-oriented technologies are available to help managers analyze and enhance their services. In this research, QFD is used to identify and prioritize remedial efforts to satisfy the needs of the consumers. Furthermore, the kano analysis is utilized to estimate the weight of various client needs. The proposed method is tested at an Iranian private hospital for better understanding. The requirements of the patients' companions were also taken into account in this study, in addition to the patients' desires. As a result, the term "client" is used throughout the rest of the text to refer to both patients and their companions.

To enhance the quality of hospital services under budget constraints, this study combines the QFD technique with Kano analysis and the Knapsack Problem Mathematical Model (KPMM). Kano devised a system for categorizing product or service attributes based on their ability to fulfill the demands of customers. These desires are grouped into five categories:

- 1) The must-have desires: these are the needs that customers anticipate and assume. Customers will be indifferent if done well but will be extremely displeased if done incorrectly.
- 2) One-dimensional desires: these characteristics lead to satisfaction when they are met and disappointment when they are not.
- 3) Attractive desires: these characteristics bring satisfaction when completely realized, but do not induce unhappiness when they are not.
- 4) Indifferent desires: these characteristics refer to characteristics that are neither excellent nor bad and do not lead to satisfaction or discontent.
- 5) Reverse desires: These characteristics pertain to a high level of success that leads to discontent, as well as the reality that no two consumers are identical.

Kano analysis has been employed by certain academics to enhance service quality. Kano analysis was established by (Materla et al 2019) to uncover a wide variety of complicated patient demands or to highlight its potential utility in the healthcare sector's continual development. A fuzzy Kano analysis was proposed by Wang and Fong to detect consumers' views and boost their happiness with airline services. Behdiolu assessed the quality of services in a Europe's hotels Ali et al used the SERVQUAL technique to identify and compare the degree of patients' expectations of healthcare and how they were appraised.

The QFD is a comprehensive quality system aimed at translating client desires into corrective actions. The house of quality (HOQ) matrix, which is divided into two parts: WHATs and HOWs, is the most important aspect of QFD. WHATs are data that indicate the needs of clients, while HOWs are data that give remedies, also known as corrective activities. The most important aspect of implementing QFD is defining and comprehending WHATs (consumer desires) and HOWs (corrective activities).

The numeric components are: (1) defined customer wants; (2) described corrective activities to satisfy consumers' wants; (3) measurements related to the weights of the customers' wants; (4) the relations between the customers' wants and the corrective tasks; and (5) the resource allocation of the corrective actions.

To get more reliable findings, several researchers combined QFD with other approaches. Fauziah investigated the integration of QFD and SERVQUAL for use in a hospital pharmacy. To enhance hospital service quality, Raziei designed an integrated model combining QFD, SERVQUAL, and group decision-making. Wibawa proposed a method for improving the hospital information system at a private hospital by combining SERVQUAL and Kano with QFD. (Gao and Zhanget al 2015) established hidden costs of quality stemming from patient discontent and calculated these costs using the QFD and SERVQUAL techniques. (CamgözAkda, M. Tarm et al 2013) used QFD to enhance service quality in the healthcare business. The knapsack problem, on the other hand, is a combinatorial optimization problem in which you must decide how many of each item to include in a collection so that the total weight is less than or equal to a specific limit and the total value is as great as feasible.

The simultaneous integration of QFD and Kano analysis has been addressed in a few research. Garibay demonstrated how combining the Kano analysis and the QFD may be used to assess the quality of digital library service at a Mexican institution. To improve hotel services, (Kuo et al 2016) looked at combining the Kano analysis with the QFD technique. In the sphere of life insurance services, Vaziri and Beheshtinia combined QFD, SERVQUAL, and the kano analysis. (Baki et al, 2009) used the QFD technique and its integration with SERVQUAL and kano analysis to create a model to improve logistics service quality.

By combining QFD with the Kano analysis and the SERVQUAL analysis, Beheshtinia and Farzaneh Azad developed a methodology to increase the quality of hotel services. Furthermore, in healthcare systems and hospital services, several studies combine QFD with kano analysis. According to the literature, using techniques such as MCDM, SWOT, QFD, and others in diverse case studies can lead to new results, and it can be argued that using the same approach in multiple firms in the aforementioned scopes contributes. Implementing QFD in multiple businesses, for example, may result in new consumer demands or technological needs. The preceding articles are organized by the instruments used in the research and the case studies. Examining earlier work (Yeh TM et al, 2010). Following is a list of research contributions:

- QFD, Kano analysis, and KPMM are all being integrated into healthcare services.
- Implementing the recommended strategy in a hospital in Pandian Heart Center, Madurai, Tamilnadu, India and finding a new target population.

## METHODS

The key research topic in this study is as follows:

- What is the best set of corrective measures to improve the quality of hospital services while staying within a budget? The following are the research sub-questions:
  - What are the needs of hospital patients?
  - Based on the kano analysis, what are the types of customers' desires?
  - What are the different levels of relevance for consumers' desires?
  - What are the weighted averages of customers' desires?
  - What are the necessary corrective actions to meet the needs of the identified customers?
  - What is the link between remedial actions and the desires of the customers?
  - What is the projected cost of putting each specified corrective action into action?

## Data Gathering

This study employs four different types of questionnaires. The first questionnaire is based on a Kano analysis to establish the customer's desires. The questionnaire comprises two positive and negative questions concerning taking into account or neglecting each need in the hospital's services.

The second questionnaire determines the importance of the consumers' desires. The items in both surveys were answered using a 5-point Likert scale. Scores 1 to 5 (from least to most important) are ascribed to the importance degree of needs from the clients' perspective, as indicated. Finally, the mean of significance scores for each requirement is derived based on the scores obtained from clients.

The third questionnaire is used to assess the link between consumer desires and remedial actions, and the alternatives provided by respondents. The fourth questionnaire is used to calculate the cost of experts adopting each remedial action.

In each scenario, 385 questionnaires are distributed in the hospital for five months, according to Cochran's calculation, assuming a 5% error. The Cronbach alpha test was used to confirm the questionnaire's reliability.

### Research Steps

This study uses a QFD strategy in conjunction with kano analysis and KPMM to improve the quality of hospital services while staying within a budget. The steps of the research are outlined below. Figure 1 depicts a flowchart of the research process.

Step 1: Determine what the customers want. Expert comments, literature reviews, and consumer interviews all help to identify these desires.

Step 2: Determine the remedial actions necessary to meet the needs of the consumers.

Step 3: Determine the relationship matrix. At least one of the consumer desires is addressed by each remedial activity. To demonstrate and simplify these interactions, the HOQ relationship matrix is employed. The HOQ matrix's rows and columns represent the consumers' desires and corrective actions, respectively.

Step 4: Assess the importance of your client's desires. The second questionnaire aids in determining the importance of the consumers' desires. The higher the importance of want, the more attention it should receive from management.

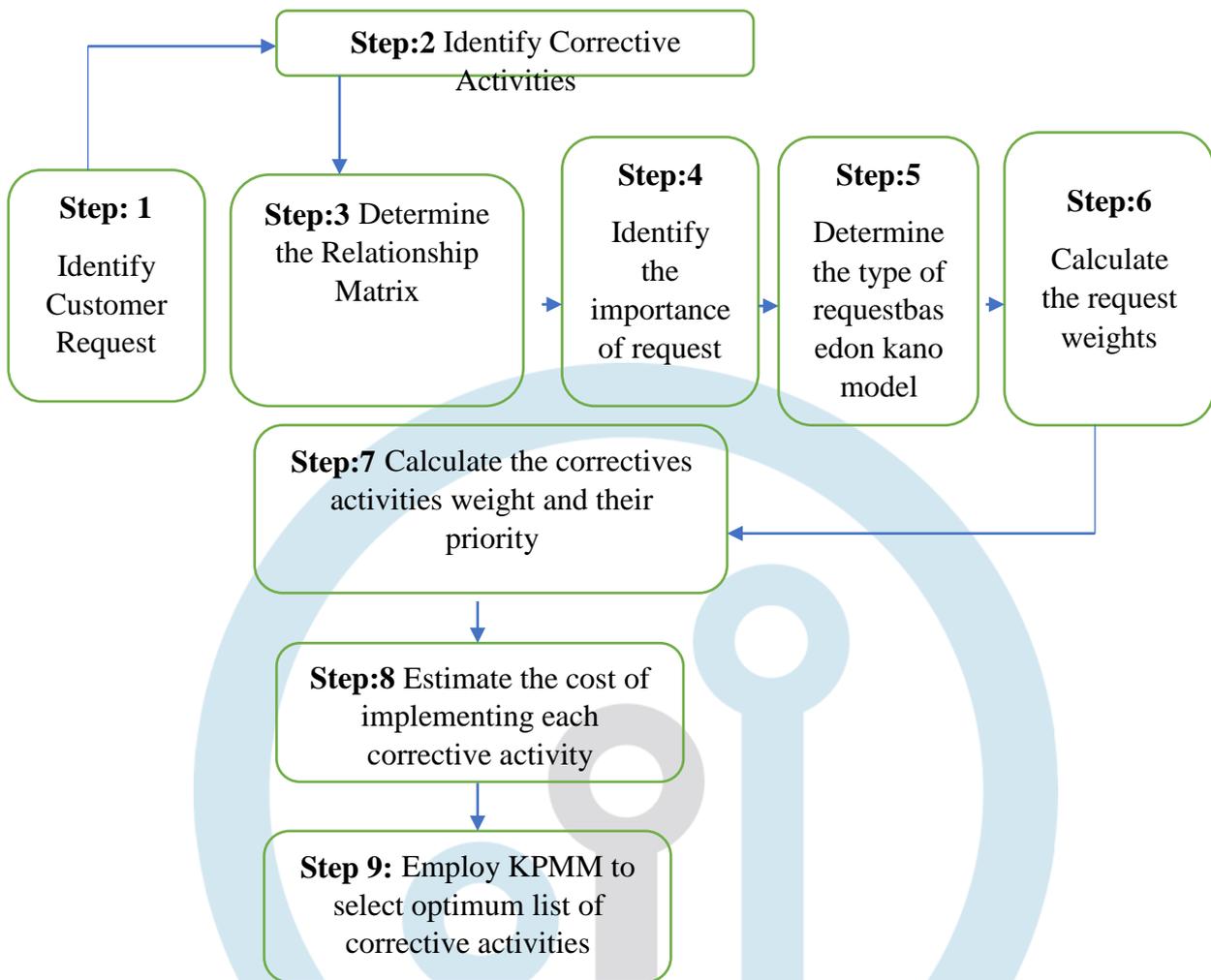
Step 5: Using the Kano analysis, determine the kind of desires. Using the second questionnaire, the consumers' desires are classified into five categories: must-be, one-dimensional, appealing, indifferent, and reverse wishes.

Step 6: Determine the importance of the consumers' desires. The values of each customer's priority degree are multiplied by its kind to compute the ultimate weight of each customer's desire.

The associated values to the different types of needs are decided by the company's strategies. If the goal is to keep present clients, a higher priority should be given to fundamental needs. If the organization's goal is to attract new clients, appealing desires should be given a higher priority.

$$AW_i = K_i \times I_i \quad (1)$$

$$RW_i = AW_i / \sum_{i=1}^n AW_i \quad (2)$$



**Figure 1 Overview of research steps**

Step 7: Determine the importance and weights of the remedial activities. The value of remedial exercises isn't the same. Some remedial tasks need a greater level of attention than others. The weights of the remedial actions are computed using the following equation:

$$AEW_j = \sum_{i=1}^n dij \times AW_i \quad (3)$$

$$RW_i = AW_i / \sum_{i=1}^n AW_i \quad (4)$$

where  $AEW_j$  is the absolute weight of corrective action  $j$ ,  $dij$  is the value of the desire icorrective activity  $j$  connection, and  $REW_j$  is the relative weight of corrective activity  $j$ . A larger weight for a corrective activity suggests that it is more important and urgent for management to undertake.

Step 8: Calculate the cost of each remedial action.

Step 9: Use KPMM to choose the best set of remedial activities. The KPMM is used to identify the best set of corrective activities:

$$Max Z = \sum_{j=1}^m REW_j \times X_j$$

$$St : \sum_{j=1}^m C_j \times X_j \leq B$$

$$X_i \in \{0,1\} \quad i = 1,2, \dots, n$$

Where B is the budget and  $X_j$  denotes the decision variable, which is 1 if corrective activity j is chosen and 0 otherwise. The weight of j activity and its anticipated cost is represented by  $REW_j$  and  $C_j$ , respectively.

## Results

The proposed technique was tested in a private hospital in Pandian Heart Center, Madurai, to demonstrate its effectiveness. This section presents the outcomes of putting the research stages into practice.

### Identifying the Needs of Customers

The needs of the clients are recognized in the first stage. In addition to medical needs, mental health and other customer-related services are taken into account. Finally, 30 desires were discovered.

### Identifying the Remedial Actions

The performance of the hospital can be systematically enhanced by executing corrective activities that are prioritized. At this point, 30 remedial tasks have been identified to meet the needs of the consumers.

### Creating the Matrix of Relationships

The link between each corrective activity and each consumer's want is identified in this stage, utilizing the third questionnaire.

### Identifying the Value of Customers' Desires

The significance levels of the desires elicited from the second questionnaire are displayed. As determined, the R24, R14, and R26 clients' needs are of the utmost priority.

**Determine the Kind of Desires the Kano Analysis was used to make this decision.** The symbols M, O, and A stand for "must-be," "one-dimensional," and "attractive," respectively. Depending on the organization's strategy, the weight ascribed to each sort of want may change. The focus is on "Must-be" wants if the organization aims to maintain the existing state. As a result, this form of desire is given more weight. If the organization's objective is to attract new clients, the "attractive" wants are different.



Customers' requests	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26	R27	R28	R29	R30
Friendly environment																														
Pharmacy with enough variety and drugs																														
Proper parking with easy access																														
High capacity waiting rooms																														
Proper care after surgery																														
Taking care of patients																														
Fast and safe patient transfer																														
Adequate beds																														
Appropriate assistance to patients																														
Suitable size and tidy environment																														
Safe devices and equipment																														
The presence of a relaxing environment																														
Provide patient health information to fellows at any time																														
Enough manpower																														
Healthy food and variety																														
Environmental cleanliness																														
Proper behavior of the staff																														
Adequate and modern medical equipment																														
Timely and appropriate treatment																														
Proper guidance for clients																														
Considering a special environment for children																														
Low waiting time for surgery																														
Pay attention to client stress																														
Special attention to specific patients																														
Healthy and sufficient consumables																														
Professional and experienced doctors and nurses																														
Provide sufficient information centers																														
The nice interior design																														
Good buffet with full and varied menu																														
Elevator and construction equipment failure reduction																														
Consulting and educating clients and patients																														
Creating an accurate information system																														
Increase staff sense of responsibility																														
Use alarms to declare a patient's health status																														
Strengthen laboratories																														
Increase patient appointment time																														
Timely remedy deficiencies																														
Use of safety equipment to transport of patients																														
Create enough space for traffic																														
Prepare descriptions for devices and equipment																														
Providing comfortable and clean patients' clothes																														
Training of physicians and nurses																														
Use of modern construction equipment																														
Perform a timely and proper examination																														
Providing entertaining equipment for patrons																														
Reinforcement of reception system																														
Provision of comfort facilities for clients																														
Hiring experienced surgeons, specialists and nurses																														
Providing modern medical equipment																														
Balancing between the number of patients and staff																														
Improve environmental conditions																														
Periodic replacement of medical equipment																														
Use color labels for equipments																														
Use signage and warning signs																														
Increasing the variety and quality of foods																														
Training the hospital cleaning crews																														
Improve facilities and mechanize cleaner equipment																														
Establish personalize facilities for patients																														
Increasing managers' knowledge																														
Get advice from medical equipment experts																														

Figure 2 Overview of research steps

**Calculating the Value of Customers' Desires**

The ultimate weights of the consumers' demands are shown in Table 1, with R26, R25, and R16 having the greatest weight.

**Calculating the Corrective Activity Weight and Prioritization**

The weights of the remedial actions are computed in this phase using equations (3) and (4). The absolute weight, relative weight, and corrective activity ranks are shown in Table 5, with A12 and A3 having the greatest weight and A11 and A6 having the lowest weight.

CLIENT REQUEST	Important Degree	Request Type	Kano Weight	Absolute Weight	Relative Weight
R1	3.982	O	3	11.945	0.024
R2	4.252	M	5	21.26	0.044
R3	4.281	M	5	21.408	0.044
R4	4.174	M	5	20.87	0.043
R5	4.351	M	5	21.753	0.045
R6	4.501	O	3	13.504	0.028
R7	4.317	O	3	12.951	0.027
R8	4.153	O	3	12.46	0.026
R9	4.205	O	3	12.616	0.026
R10	4.475	M	5	22.377	0.046
R11	4.499	M	5	22.494	0.046
R12	4.41	O	3	13.231	0.027
R13	4.362	O	3	13.085	0.027
R14	4.566	O	3	13.699	0.028
R15	4.083	O	3	12.249	0.025
R16	4.514	M	5	22.571	0.046
R17	4.39	M	5	21.948	0.045
R18	4.353	O	3	13.06	0.027
R19	4.514	O	3	13.543	0.028
R20	4.34	M	5	21.701	0.044
R21	4.322	A	1	4.322	0.009
R22	4.47	O	3	13.41	0.027
R23	4.249	O	3	12.748	0.026
R24	4.605	O	3	13.816	0.028
R25	4.532	M	5	22.662	0.046
R26	4.54	M	5	22.701	0.046
R27	4.275	M	5	21.377	0.044
R28	4.309	O	3	12.927	0.026
R29	4.184	A	1	4.184	0.009
R30	4.306	M	5	21.532	0.044

Table 1: The Degree of Importance, Type and Weight of the Wants

**Estimating the Cost of Buying Each Corrective Action in Place**

The fourth questionnaire is used to determine the cost of implementing each remedial activity in this stage. Table 2 summarises the findings.

Rank	Corrective Activity	Absolute weight	Relative Weight	Estimated Cost
1	A12	2807.789	0.118	52000
2	A3	1627.345	0.068	9000
3	A18	1446.789	0.057	69000
4	A20	1360.043	0.053	169000
5	A24	1307.612	0.049	1000
6	A2	1248.642	0.045	17000
7	A19	1213.092	0.032	169000
8	A1	1163.356	0.029	17000
9	A13	1141.904	0.026	169000
10	A7	1067.338	0.026	9000
11	A29	923.9935	0.025	17000
12	A14	771.192	0.02	17000
13	A16	729.498	0.02	17000
14	A21	688.6482		9000
15	A9	686.627		52000
16	A22	613.8711		169000
17	A5	607.5665		85000
18	A17	589.0441		34000
19	A8	475.7866		33000
20	A4	475.1257		32000

21	A30	421.4588	0.018		1000
22	A27	404.2391	0/017	69000	
23	A10	325.7928	0/014 0.014		1000
24	A26	322.9543	0.013	17000	
25	A23	311.1328	0.013 0.009		1000
26	A15	301.714	0.007 0.007	17000	
27	A25	223.3374	0.006	17000	
28	A6	177.7658			9000
29	A28	170.1846		53000	
30	A11	153.3022		17000	

**Table 2 Summary of findings**

### Use KPMM to choose the best set of corrective actions.

Using KPMM, the ideal list of corrective tasks is generated for various budget values. All corrective actions are selected if the allotted budget equals the total of the corrective activity costs. However, if the given budget is less than the total cost of corrective actions, certain corrective tasks will be skipped.

### Discussion

The following are some of the benefits of the suggested method:

- Improving hospital service quality by taking into account the type of demand and its priority level when evaluating the weight of customers' desires.
- Using the organization's strategy to determine the importance of consumers' demands and, as a result, the importance of corrective actions, as previously discussed.
- Choosing the best set of remedial actions within a financial restriction.

If an original QFD technique is used, such as the forceful QFD in, the client's desires for "Special attention to individual patients," "Enough manpower," and "Professional and experienced physicians and nurses" receive the most weight because they are the most important. However, among all client desires, "Professional and experienced physicians and nurses," "Healthy and plentiful consumables," and "Environmental cleanliness" received the greatest weight in this study. It's because these clients' desires are "Must-haves," and their priority levels are magnified by a large factor. Even though "Special attention to individual patients" and "Enough personnel" have the highest significance degrees, their types are "Onedimensional," and their importance degrees are multiplied by a lower coefficient. The outcomes of the exerted method are variable, and by modifying the organization's strategy, the Kano weights and the weights of the clients' demands would vary as well.

The Kano analysis was used to determine the weights of the customers' wants, which allowed the organization's plans to be taken into account while evaluating the priority of corrective efforts. The weight allocated to each sort of desire may be varied depending on the organization's strategy. Using KPMM, on the other hand, leads to the selection of the best set of corrective activities within a budget restriction.

### Conclusion

Hospitals, like other service businesses, provide services to their clients and strive for customer satisfaction. The goal of this study was to improve hospital service quality by combining QFD with Kano analysis and KPMM. To accomplish this, the customer's desires were first determined, followed by the corrective actions necessary to meet them. As a result, the link between each client's wants and each corrective action was discovered. The Kano analysis was then used to assess the significance and kind of each consumer request. The weight of each client's desires and remedial action was then computed.

Finally, using KPMM, the cost of performing each corrective action is assessed, and the set of optimum corrective activities is established under budget constraints. To have a better understanding of their consumers, hospital executives should evaluate the provided list of client desires and corrective measures. The importance and weight of remedial efforts are proportional to the importance of the clients' desires. As a result, every shift in the weight of customers' desires shifts the priority of clients' desires. Managers are advised to use the recommended strategy and deal with their plans by giving ratings to different types of customer desires. Managers should also utilize KPMM to select the best set of corrective measures when working with a limited budget.

A future study might look at applying the proposed technique to additional service firms including banks, hotels, and training institutions. Adding other approaches to the methodology, such as MCDM techniques (Beheshtinia M, Omidi S et al 2017), data envelopment analysis (Peykani P, Mohammadi E et al. 2016; Peykani P, Mohammadi E et al. 2018), or supply chain aspects (Ghannadpour SF, Zarrabi A et al, 2019), might be a future study topic. A future study might also look at using fuzzy approaches to determine the weight of remedial efforts.

## References

1. Baki B, SahinBasfirinci C, Murat AR I, Cilingir Z. An application of integrating SERVQUAL and Kano's model into QFD for logistics services: a case study from Turkey. *Asia Pacific Journal of Marketing and Logistics*. 2009;21(1):106- 126. doi:10.1108/13555850910926272
2. Camgöz-Akdağ H, Tarım M, Lonial S, Yatkın A. QFD application using SERVQUAL for private hospitals: a case study. *Leadersh Health Serv*. 2013;26(3):175-183. doi:10.1108/LHS-02-2013-0007
3. Gao N, Zhang Y. Healthcare service hidden quality cost estimation based the SERVQUAL and QFD method. In: Qi E, Shen J, Dou R, eds. *Proceedings of the 22nd International Conference on Industrial Engineering and Engineering Management 2015*. Paris: Atlantis Press; 2016. doi:10.2991/978-94-6239-180-2\_41
4. Ghannadpour SF, Zarrabi A. Multi-objective heterogeneous vehicle routing and scheduling problem with energy minimizing. *Swarm EvolComput*. 2019;44:728-747. doi:10.1016/j.swevo.2018.08.012
5. Hatefi SM, Haeri A. Evaluating hospital performance using an integrated balanced scorecard and fuzzy data envelopment analysis. *Journal of Health Management & Informatics*. 2019;6(2):66-76.
6. Kuo, C.M., Chen, H.T., and Boger, E. Integrating Kano and QFD analytical models to improve the quality of city hotel services. *J Hospital Market Management is a company that manages hospitals*.
7. Materla T, Cudney EA, Antony J. The application of Kano model in the healthcare industry: a systematic literature review. *Total Qual Manag Bus Excell*. 2019;30(56):660- 681. doi:10.1080/14783363.2017.1328980.
8. Peykani P, Mohammadi E, Pishvae MS, Rostamy- Malkhalifeh M, Jabbarzadeh A. A novel fuzzy data envelopment analysis based on robust possibilistic programming: possibility, necessity and credibility-based approaches. *RAIRO - Operations Research*. 2018;52(4- 5):1445-1463.
9. Peykani P, Mohammadi E, Jabbarzadeh A, Jandaghian A. Utilizing robust data envelopment analysis model for measuring efficiency of stock, a case study: Tehran Stock Exchange. *Journal of New Researches in Mathematics*. 2016;1(4):15-24.
10. Torkzad A, Beheshtinia MA. Evaluating and prioritizing hospital service quality. *Int J Health Care Qual Assur*. 2019;32(2):332-346. doi:10.1108/ijhcqa-03-2018-0082.
11. Vaziri J, Beheshtinia M. A holistic fuzzy approach to create competitive advantage via quality management in services industry (case study: life-insurance services). *Management Decision*. 2016;54(8):2035-2062. doi:10.1108/MD-11-2015- 0535
12. Yeh TM. Determining medical service improvement priority by integrating the refined Kano model, Quality function deployment and Fuzzy integrals. *Afr J Bus Manag*. 2010;4(12):2534-2545.



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