The combined application of Quality Function Deployment and Pareto analysis for hotel services improvement

S.A. Oke*

Department of Mechanical Engineering,
University of Lagos,
Room 10, Mezzanine Complex,
Akoka-Yaba, Lagos, Nigeria
Fax: +234-1-493-2667
E-mail: sa_oke@yahoo.com
*Corresponding author

C.E. Ofiabulu

Department of Industrial and Production Engineering,
University of Ibadan,
Engineering Annex Building,
Ibadan, Nigeria
E-mail: ofiabuluce@yahoo.com

A.A. Banjo

Department of Mechanical Engineering,
University of Lagos,
Room 10, Mezzanine Complex,
Akoka-Yaba, Lagos, Nigeria
E-mail: sa_oke@yahoo.com

O.G. Akanbi and F.A. Oyawale

Department of Industrial and Production Engineering,
University of Ibadan,
Engineering Annex Building,
Ibadan, Nigeria
E-mail: engrakanbi@yahoo.com
E-mail: festwale@yahoo.com

Abstract: This paper discusses the combined application of Quality Function Deployment (QFD) and Pareto Analysis (PA) to hotel services. This paper improves the current quality management practices in a case study hotel. This results into increased customer patronage and improved hotel profit margin. PA is applied as a prioritisation tool for the purpose of financial investment decision. The study may be applicable to other hotels. It could also significantly affect the goodwill of the organisation as well as its profit margin. This paper is new, in that it appears to be the first application of Pareto cum QFD principles in hotel services, and a new way of prioritisation and quality improvement in hotels systems.

Biographical notes: S.A. Oke graduated in Industrial Engineering from the University of Ibadan, Nigeria with Bachelor and Master's degrees in 1989 and 1992, respectively. He worked in IDM Services Limited as a Consultant and currently Lectures in the Department of Mechanical Engineering, University of Lagos. He has reviewed papers for international journals.

C.E. Ofiabulu received his BSc from the Federal University of Technology, Owerri and MSc. from the University of Ibadan. Currently, he is working on his PhD in Industrial Engineering from the University of Ibadan. He has published in international journals.

A.A. Banjo graduated with BSc (Hons) in Industrial Engineering from the University of Ibadan, Nigeria.

O.G. Akanbi received his BS from Ohio State University, USA, an MSc and an MBA from Oklahoma State University, and a PhD from University of Ibadan. He is a Member of Nigerian Institute of Industrial Engineering, Member of the Nigerian Society of Engineers and a Registered Engineer with the Council of Registered Engineers of Nigeria. He was the General Manager of Conpole Nigeria Limited. He has presented several international and local papers and reviewed journals. Currently, he Lectures at the University of Ibadan, Nigeria.

F.A. Oyawale is a BS, an MS (Western Michigan) and a PhD (Benin). He is a Member of the Nigerian Institute of Industrial Engineers. He is also a Registered Engineer and specialises in Production Engineering. He is currently the Post-Graduate Co-ordinator in the Department of Industrial and Production Engineering, University of Ibadan. He has published several books for undergraduate courses and has several years of teaching and research experience.

---

1   Introduction

For several years, Quality Function Deployment (QFD) has been at the leading edge of research and development in many fields (Barnett and Raja, 1995; Chiou and Tong, 2001; Han et al., 2001; Pitman et al., 1996; Pramod et al., 2007; Walker, 2002; Wang, 2007). QFD evolved as a way to incorporate knowledge about the needs and desires of end-user customers into all stages of the design, manufacture, delivery and support of products and services (Einspruch, 1996; Griffin and Hauser, 1993; Kathawala and Motwani, 1994; Knights, 2001; Maddux et al., 1991; Tan et al., 1998). Many world-class organisations have successfully used QFD (Barnett and Presley, 1998; Dijkstra and van der Bij, 2002).

Usually, in order to achieve significant results, organisations that are implementing QFD should have operational quality systems in place (Foster, 2006; Unal and Dean, 1991). QFD is then introduced to support the quality improvement drive that results in significant improvement in performance. If the leadership of the organisation is dedicated, visionary, with clear strategic intent, having a strong focus on the development of competencies within the organisation, then a total change in organisation culture and significant investment in information technology will create a successful and profitable organisation.

QFD implementation in service systems is widely documented in the literature (Hwarng and Teo, 2001; Shin et al., 2002). In the construction field, QFD has been applied in low cost housing design (Abdul-Rahman et al., 1999), for assessing the corporate service quality performance of design contractor (Arditi and Lee, 2003), as a customer-oriented design method and in the design phase of an apartment construction project (Gargione, 1999). In marketing, Orth (2000) introduces an integrated framework that links market research with operations management for the purpose of providing information for planning production, allocating resources and changing market strategies. For software, it has been applied in the design, development and implementation of QFD principles (Herzwurm and Schockert, 2003; Islam et al., 2007; Scheurell, 1994). Some papers have integrated fuzzy logic, artificial neural networks and the Taguchi method to resolve some of the QFD drawbacks (Unal and Dean, 1991). A synergy between QFD and these methods and techniques has also been proposed (Richardson, 1997). In healthcare, it is applied in new methods development (Dijkstra and van der Bij, 2002; Einspruch, 1996; Moores, 2006). Most of these studies have concentrated on customer expectations and comparisons with competitions (Griffin and Hauser, 1993).

A review of additional relevant literature is given as follows: the area of fuzzy application to QFD is well explored in the literature. For example, Fung et al. (2006) estimated the functional relationships for QFD under uncertainties. Chen and Weng (2006) presented an evaluation approach to engineering design in QFD processes using fuzzy goal programming models. Bevilacqua et al. (2006) investigated a fuzzy-QFD approach to supplier selection, while Bottani and Rizzi (2006) reported a fuzzy-QFD application to strategic management of logistics service. Kahraman et al. (2006) considered a three-dimensional system which combined fuzzy optimisation, QFD and analytic network approach. Büyüközkan et al. (2007) discussed the fuzzy group decision-making application to multiple preference formats in QFD. Chakraborty and Dey (2007) presented a QFD-based expert system for non-traditional machining processes selection. Cagno and Trucco (2007) explored the integrated green and QFD. The rating of technical attributes in fuzzy QFD by integrating fuzzy weighted average method and fuzzy expected value operator was provided by Chen et al. (2006).

Unfortunately, papers reflecting the use of QFD in hotel systems are rare (Robaina and Rodriguez, 2007). Hotels employ thousands of people and generate high incomes annually in value-added services. Thus, any quality improvement in this industry will have a significant effect on costs and market competitiveness. The traditional QFD framework is weak in that it does not give a lead on how to pick a 'few selected items' from a series of items. This is a shortcoming in the existing literature. This work proposes a Pareto-based analytical method with an application in a hotel (Craft and Leake, 2002; Knights, 2001) since the hotel industry is an important service sector component.

The structure of this paper is as follows. The introduction provides a strong motivation for the study and its justification. Section 2 presents the methodology for the problem. Section 3 discusses a case study of a typical hotel. Section 4 shows the application of the Pareto principle. Section 5 presents the lessons learnt from the case study, concluding remarks and implications of the study.

2   Methodology

This section presents the steps taken in applying QFD in the chosen organisation. Steps 1 and 2 are termed the market survey. The first step focuses on the conduct of the interview, which involves determining the Customer's Attributes (CA's) by directly interviewing them. The second step involves the design and administration of the questionnaire. This leads the researcher to the third stage – construction of the House of Quality (HOQ). Step 4 analyses and presents the results. Customer's requirements and how to meet them were determined. The details of the four steps are as follows.

2.1   Conduct initial interview (step 1)

The details of the operations and activities of the hotel were discussed with the General Manager, the Operations Manager and the Accountant. Through visual observation of the premises, we gained familiarisation with the hotel. The target customers are mainly those who spend the night in the hotel and other customers. Next, the questions to ask the interviewee were developed. Finally, the interview was conducted. The interviewer was flexible such that when a line of question opens up that is different from what has been planned; he/she was free to follow it.

2.2   Designing and administration of survey instrument (step 2)

Two important tools were used for analysis, namely, the tree charts/diagrams, and the Kano questionnaire. The tree charts/diagrams are used to keep the line of the questioning in manageable form. The important documentation made by the respondent during the interview is in the form of a tree diagram. The review of the tree diagram helped in the structuring of questions for the next person to be interviewed. Two important parameters included in Kano questionnaire are customers' attributes and ratings. CA's refer to the voice of customer or customer's needs and expectations (Lee and Lin, 2006). It has *importance weight* attached to it and is divided into three categories as stated in Table 1.

Table 1   Customer attributes

Must-be's	These are characteristics the customer expects to be present. If they are absent, the customers are deeply dissatisfied. But if they are present, they do not contribute significantly to customer's satisfaction. All the attributes in this category were given a weightage of five
One-dimensional	These are characteristics, which the customer looks for. The better the product or service rendered on these attributes, the happier is the customer. Customer attributes in this category were given a weightage of three
Attractors	Also known as delighters, these are characteristics that excite the customer because they were unexpected and are very useful to have. CAs in this category were given a weightage of two

2.2.1 Kano questionnaire

Kano questionnaire (see Hauser and Clausing, 1998) assists in categorising the different characteristics of the system under consideration. The questions in the questionnaire are organised as pairs, each with the possible responses (see Appendix). Based on an initial survey, the following list of CA's and ratings were obtained from the 27 attributes that the hotel was found to possess. Apart from this 'importance ratings', the 27 attributes were identified by the customer since they are to decide on the quality of value they obtain from the system. The 27 attributes were categorised into seven main groups. The items under each group are related. For instance, the first group is 'room', having four related items under it: room entertainment, cool room, room decoration and bathroom amenities. The corresponding ratings are 4, 4, 4 and 5, respectively. All these details are given in Table 2 (see Table 3 also).

Table 2   List of customer attributes and ratings

	Room			Security			Leisure	
	Attributes	Importance ratings		Attributes	Importance ratings		Attributes	Importance ratings
1	Room entertainment	4	8	Safe environment	5	18	Exercise room	3
2	Cool room	4	9	Safety of life	1	19	Music room	3
3	Room decoration	4	10	Safety of property	4	20	Sports hall	3
4	Bathroom amenities	5		*Food service*		21	Swimming pool	1
	External factor		11	Meal availability	4		*Services*	
5	Courtyard	3	12	Free continental meal	4	22	Reservation booking	4
6	Water availability	5	13	Low price	3	23	Laundry service	4
7	Corridor view	1	14	Kitchen facilities	4	24	Message service	3
				Lounge		25	Secretarial service	1
			15	General appeal	4	26	Car Mtce. (Emerg.)	3
			16	Atmosphere of hotel	5	27	Conference room	3
			17	Food menu	5			

Table 3 indicates that if the majority of responses for a specific pair are in cell marked 'A', then that is an attractor. If the cell is marked 'O', it is one-dimensional. If it is marked 'M', it is a must-be. Characteristics in cells marked 'I' are those for which the customer shows no preference. If the majority of responses fall in a cell marked 'R',

it indicates that the customer would not like those characteristics. Responses in the cell marked 'Q' indicate that some customers would like the characteristic to be present while others would not like.

Table 3   Kano classification of customer attributes

			Negative				
			1	2	3	4	5
			Like	Must-be	Neutral	Live with	Dislike
Positive	1	Like	Q	A	A	A	O
	2	Must-be	R	I	I	I	M
	3	Neutral	R	I	I	I	M
	4	Live with	R	I	I	I	M
	5	Dislike	R	R	R	R	Q

Both the customer assessment rating and technical assessment rating were employed in this work. Customer assessment rating, having the rating scale called the semantic differential with end-point bounded by opposite objects was presented to the customer for rating the various attributes. The advantage of closed-ended rating scale was that customer could respond by simply ticking the box. The researchers and the operations manager performed the technical assessment rating. The operations manager is an employee of the organisation responsible for directing the activities of the hotel. He provides the necessary knowledge to solve problems and to implement the solutions developed. The operations manager worked with us in using the semantic differential rating scale. The *consumer assessment rating* and the *technical assessment rating* were attempts to benchmark the best company.

Having discussed two of the steps in the procedure for implementing QFD, the third issue that is addressed in the following section is to construct the HOQ.

2.3   Construction of the HOQ (step 3)

The preparation of the HOQ requires eight major steps (see Appendix). In this discussion, we shall apply these general steps in the hotel case study examined.

Stage 1   Determine the whats (A): this is the 'voice of the customer' or customer's needs and expectations. They are called CA's and are enumerated in the HOQ's left-hand wall. The data for this have been previously given in Table 2 and could be observed in the diagram for the HOQ, which is shown in the Appendix.

Stage 2   Transform the whats to hows (D): while noting that we have '27 whats', each of these items needs to be converted into 'hows'. A deep thinking on how the 'whats' would suggest the engineering characteristics. Here, we demonstrate an example of how engineering characteristics could evolve from the customer attributes or 'whats'. Consider the item 'room entertainment' which is one of the 27 CA's identified in the hotel. The attribute could develop into six engineering characteristics namely: colour TV, channels, video player, rental cassette, CD players and magazine. These are items 1–7 in Table 4 that gives the list of engineering characteristics.

The rest of the items in Table 4 (i.e. items 7–71) are obtained from the list of 27 CA's defined earlier in Table 2. The next step is to classify the list of CA's into 'must bes', 'one dimensional' and 'attractors'. This is given in Table 5. The step that now follows is Stage 3 of the construction of the HOQ.

Table 4   List of engineering characteristics

1	Colour TV
2	Colour TV/Channels
3	Video player
4	Rental cassette
5	CD player
6	Magazine
7	Air conditioner
8	Window shape
9	Reservation desk
10	Precredit clearance
11	Bell man
12	Light on phone
13	Note on front desk
14	Message under door
15	Clip drop off and pick up
16	Information board
17	Photocopying machine
18	Typewriter
19	Typist
20	Office equipment
21	Hotel driver
22	Screen projector
23	Lighting style
24	Conference chair
25	Hotel car
26	Mic. at desk
27	Tree plant
28	Garden
29	Flower
30	Reservoir (water)
31	Hotel location
32	Sound proof wall
33	Sprinkler system

Table 4   List of engineering characteristics (continued)

34	Generator
35	Indirect lighting
36	Household supplies
37	Std. size sink
38	Quiet bar lounge
39	Balcony shape
40	Sofa
41	Background music
42	Hotel guest and friends
43	Rest. in hotel
44	Rest. nearby
45	Full service rest.
46	Meal sale price
47	Fast food
48	Quantity of food
49	Waiter
50	Foodstuff
51	Snacks bar
52	Phone in order
53	Cook
54	Refrigerator
55	Night singer
56	Musical instrument
57	Training weight
58	Running machine
59	Trainer
60	Table tennis facilities
61	Computer games
62	Sports shop
63	Smoke detector
64	12 hr video camera
65	Fire alarm
66	Parking area attendant
67	Check in/out system
68	Security guard
69	Security light
70	Fire extinguisher
71	Lighting protector

Table 5(a)   List of customer attributes (classified)

List of customer *Must-Bes*

1	Bathroom amenities	2	Safe environment	3	Water availability	4	Good atmosphere	5	Food menu
6	Safety of Life								

Table 5(b)   List of 'one-dimensional' attributes

1	Room entertainment	2	Cool room	3	Room decoration	4	Reservation booking	5	Safety of property
6	Meal availability	7	Laundry service	8	General appeal	9	Free Cont. meal	10	Kitchen facilities
11	Swimming pool								

Table 5(c)   List of customer attractors

1	Courtyard	2	Low-price	3	Message service	4	Car Mtce. (emerg.)	5	Conference room
6	Exercise Room	7	Music room	8	Sport hall	9	Atmosphere of hotel	10	Corridor view

Table 5(d)   List of customer attributes that should be focused on by the hotel for quality improvement

1	Room entertainment	2	Cool room	3	Room decoration	4	Bathroom amenities	5	Courtyard
6	Water availability	7	Corridor view	8	Reservation booking	9	Laundry service	10	Message service
11	Secretarial service	12	Car Mtce. (emerg.)	13	Conference room	14	Safe environment	15	Safety of life
16	Safety of property	17	Meal availability	18	Free Cont. meal	19	Kitchen facilities	20	Exercise room
21	Music room	22	Sport hall	23	Swimming pool	24	General appeal	25	Good atmosphere
26	Food menu	27	Room entertainment						

Stage 3 Determine the nature of the relationship between the whats and hows using the relationship matrix (E): the relationship matrix reveals the correlation between the CAs and the ECs. Following the traditional convention, three levels of correlation were observed through intuitive experience. They are given the following symbol weights and descriptions:

Description	Symbols	Weights
Weak	△	1
Medium	◆	2
Strong	●	8

Symbols would first be used to represent the relationship between the *whats* and the *hows* in the HOQ before actual numerical values are used to represent the absolute values of the weights. It is then transformed into relative positions. This is reflected in Figure A1 (Appendix), which represents the HOQ in the Appendix. Take 'water availability' for instance, which is one of the 'must bes'. In the HOQ diagram, the intersection between 'water availability' and 'reservoir (water)' is denoted by the symbol representing 'medium'. This has a value of two. The same procedure applies for all entries in the HOQ.

Stage 4   Establish the quantity of data needed (I): based on experience, the number of customers who visit the hotel totals 200 on a daily basis. However, due to resource and time constraint for the research, the target number of respondent was limited to 50. The averages of the values obtained from each respondent through questionnaire administration were summed up and used in the computation of the HOQ data. This is show in Table A1 (Appendix).

Stage 5   Correlate each how to each other how (F): this is done in the correlation section or roof of the house like matrix.

Stage 6   Complete the customer and technical evaluation sections: the customer evaluation relates the product features to customer satisfaction (V). The technical evaluation assesses the product based on technical merit (G). At this stage, the company's brand/product is compared with those of its competitors on technical goodness on a five-point scale.

Stage 7   Assign or calculate importance rating (B): this helps to prioritise analysis effort. This was done using the Kano questionnaire.

Stage 8   Calculate absolute weight (H): the weights are simply the sum of correlation given in the relationship matrix (rooms), each multiplied by its corresponding customer weights. For an illustrative example, consider the column representing 'reservoir (water)'. This has five items in all. Two of the items have the symbol that represents 'weak'. Two others have the symbol that represents 'medium'. The fifth item represents 'strong'. This shows that we have a total absolute value of $(5 \times 1) + (2 \times 9) + (5 \times 3) + (3 \times 1) + (3 \times 3) = 50$.

This is obtained by taking the multiplication of the relationship correlation index of the first item along the *reservoir (water)* and the index indicating importance – rating (i.e. $(5 \times 1) = 5$). The next item has an index representing *strong* which has the value of 9. This is multiplied by 2 for the importance rating to obtain 18. These are the first 2 entries in the above calculation. Overall, we have a sum of 50 for the absolute value representing 'reservoir (water)'. Now when all these values are placed side by side for relative positioning, the item that we are considering comes up in the 12th position. The item *generator* which is about the midway in the list of design requirements comes up as 1st with an absolute value of 194. All these calculations are shown in Figure A1 (Appendix), which shows the HOQ matrix.

3   Case study

Ibadan, the largest city in West Africa, has hotels, which vary in size, status, ownership and location. The average guest-handling capacity of hotels in Ibadan varies from 150 to 500 guests. The status of the hotels in Ibadan ranges from one-star to five-star hotels. Individuals, groups or governments own hotels in Ibadan, which are located in commercial and residential areas. The financial capacity of hotels in Ibadan ranges from about ₦10 million to about ₦100 million (One dollar = ₦150), which is proportionate to the size of the hotel. From the population of hotels in Ibadan, an important one is chosen for the study based on years of existence, quality of service provided, level of satisfaction of customers with service provided, location of hotel, ownership of hotel, status of the hotel, types of services provided, the relatively high level of commercial activities in the environment, fairly good record keeping system and management commitment to quality improvement. However, the name is maintained in confidentiality. The hotel provides lodging and accommodation for guests. Bars and restaurants are available for guests who want to buy food or drinks, supermarkets and some other stores are attached to the hotels depending on the status of the hotel. The five-star hotel was established in the 1990s and has a capacity of 150-hotel rooms for guests. The management is interested in knowing how far its *customers' needs* have been fulfilled.

The business environment is competitive with a number of other hotels in the city. Since customers utilise hotel facilities that would give them the best level of service, top management of hotels need effective marketing tools as competitive strategies towards attracting customers' patronage. Cost is a weapon of competition employed. Unfortunately, it must be integrated with other tools such as quality so that customer satisfaction would be guaranteed. The hotel engages in sales of food, rental of halls/spaces for meetings, accommodation of guests and laundry services. The hotel users are mainly local and international visitors to Ibadan, and members of societies and clubs in the neighbourhood of the hotel. Respondents were sampled and recruited based on the following: age, number of years of patronage of the hotel, number of days lodged in the hotel at varying times of visits, occupation of respondents, years of employment in the hotel, financial ability of the respondent. An analysis limited to the first phase of QFD using the HOQ concept was carried out. Data were gathered with questionnaires spread out to every customer who spent the night in the hotel, and those who use the facilities of the hotel. The result, ranked and compiled into HOQ, shows the most important customers' needs, customer satisfaction level about the service and the action that must be taken bearing in mind the target of increasing customer satisfaction.

4   Application of Pareto principle

The HOQ analyses the data in a form that would reveal priorities. From the sum of the absolute scores and the calculation of the cumulative scores as percentages of the total scores, a Pareto curve could be plotted. Pareto principle was discovered by Alfredo Pareto (Craft and Leake, 2002; Knights, 2001) who found that 80% of the wealth of Italy was held by 20% of the population. This 80/20 ratio has led to the Pareto concept suggesting that frequently, 20% of causes account for 80% of an effect. Thus, concentrating on the vital few produces the greatest improvement for the minimum effort. However, in applying Pareto principle to the hotel situation, care must be taken.

Also, the context of the application must also be taken into consideration. A good example that readily comes to mind to illustrate this caution may be drawn from hospitals. For example, amputating the wrong limb for a patient in an operation would not be idehtified for the attention of the decision-maker in the system if the Pareto principle were applied to the number of errors made in an operating theatre. Clearly, this is a very serious error that needs to be captured in our analysis.

The severity of the error needs to be addressed. This would suggest that the particular error of amputating the wrong limb should demand an adequate attention. The cumulative effect is then calculated and plotted, which may or may not indicate that vital few cause as more than appropriate effect. In this paper, the approach adopted is to sum the absolute scores and then calculate the cumulative scores as percentages of the total score and then plot a Pareto curve. So, generator is ranked 1 and scores 194. Next comes Bellman with a score of 126, so the cumulative score is $194 + 126 = 320$. The total of the absolute scores is 2137. The details of the result are shown both on Table 6 and the HOQ table in the Appendix. As there are 71 items, each item is about 1.4% of the total number of items. With a horizontal axis representing number of items and the vertical axis % effect, the first plot would be 1.4% items against $194/2137 \times 100 - 9\%$ effect. The second plot would be 2.8 (2 items at 1.4%) against $230/2127 \times 100 - 15\%$ and so on. Applied to the collected data in the hotel, Table 6 gives the results. In Table 6, the list of 71 items was provided. In ranking items, a number of items were observed. For example sports shop and balcony shape, smoke detector and sprinkle system, hotel location and hotel guests/friends have absolute scores of 51 and 51, 47 and 47 and 45 and 45, respectively. Usually when rating items, if a few items are tied, the count takes the number of tied items into account. Therefore sports shop and Balcony shape could be positioned 11 and 12, smoke detector and sprinkle systems may be positioned 15 and 16 and hotel location and hotel quests/friends positioned 17 and 18, respectively. Figure A2 (Appendix) shows the graph of Pareto Analysis (PA) illustrating effect. It could be ascertained from the graph that 20% of the items listed resulted in 80% effect. Therefore, the hotel should concentrate on these items to maximise profits.

Table 6   Relative positioning of items

Position	Items	Absolute scores	Absolute scores % Total scores	Cumulative scores % Total scores
1	Generator	194	9.07	9
2	Bellman	126	5.89	15
3	Information board	84	3.93	19
4	12 hours video camera	75	3.50	22
5	Fire extinguisher	69	3.22	26
6	Trainer	66	3.08	29
7	Lighting protector	61	2.85	32
8	Security guard	60	2.80	34
9	Check in check out system	59	2.76	37
10	Fire alarm	54	2.52	40
11	Sports shop	51	2.38	42

Table 6 Relative positioning of items (continued)

Position	Items	Absolute scores	Absolute scores % Total scores	Cumulative scores % Total scores
12	Balcony shape	51	2.38	44
13	Reservoir (water)	50	2.33	47
14	Lighting style	48	2.24	49
15	Smoke detector	47	2.19	51
16	Sprinkler system	47	2.19	53
17	Hotel location	45	2.10	55
18	Hotel guest and friends	45	2.10	58
19	Flowers	42	1.96	59
20	Conference chair	42	1.96	61
21	Meal sale price	42	1.96	63
22	Reserve desk	39	1.82	65
23	Air conditioner	38	1.77	67
24	Table tennis facilities	36	1.68	68
25	Refrigerator	36	1.68	70
26	Quality of food	33	1.54	72
27	Garden	33	1.54	73
28	Security light	30	1.40	75
29	Magazine	27	1.26	76
30	Phone in order	27	1.26	77
31	Food stuff	27	1.26	79
32	Message under door	27	1.26	80
33	Tree plant	23	1.07	81
34	Cook	21	0.98	82
35	Quiet bar lounge	21	0.98	83
36	Computer games	20	0.93	84
37	Hotel car	20	0.93	85
38	Background music	18	0.84	86
39	Client drop off and pick up	18	0.84	86
40	CD player	15	0.70	87
41	Light on phone	15	0.70	88
42	Window shape	15	0.70	89
43	Note at front desk	15	0.70	89
44	Screen projector	15	0.70	90
45	Training weight	12	0.56	91
46	Running machine	12	0.56	91

Table 6   Relative positioning of items (continued)

Position	Items	Absolute scores	Absolute scores % Total scores	Cumulative scores % Total scores
47	Colour T.V	9	0.42	91
48	Typewriter	9	0.42	92
49	Typist	9	0.42	92
50	Precredit clearance	9	0.42	93
51	Colour TV/channels	9	0.42	93
52	Video player	9	0.42	94
53	Rental cassette	9	0.42	94
54	Household supplier	9	0.42	94
55	Standard size sink	9	0.42	95
56	Restaurants in hotel	9	0.42	95
57	Restaurant near by	9	0.42	96
58	Full service rest	9	0.42	96
59	Fast food	9	0.42	97
60	Photographic machine	9	0.42	97
61	Snack bar	9	0.42	97
62	Microphone at each desk	6	0.28	98
63	Mechanic	6	0.28	98
64	Waiter	6	0.28	98
65	Night singer	6	0.28	98
66	Musical instrument	6	0.28	99
67	Sofa	5	0.23	99
68	Sand proof walls	3	0.14	99
69	Indirect lighting	3	0.14	99
70	Parking area attendant	2	0.09	99
71	Hotel driver	2	0.09	100

5   Lessons learnt from case study, implications and conclusion

5.1   *Lessons learnt from the case study*

The following summarises the lessons derived from this paper. These lessons relate to key success factors and the pitfalls to avoid in the implementation of the QFD-PA framework.

1   Commitment, ability to work independently and effective communication skills are essential ingredients for a successful implementation of QFD-PA framework.

2   Success in the QFD-PA implementation process depends mostly on the amount of efforts put into it.

3   It is important to listen to customers in the spirit of QFD-PA progress in the organisation.

4   Top management commitment is a key success factor in QFD-PA implementation.

5   Training of staff of the hotel on QFD-PA and their cooperation in ensuring a successful implementation programme is essential.

6   Insufficient communication among staff should be discouraged while working on the QFD-PA implementation mission.

7   Experience in the implementation of quality management programmes helps in an easy adaptation to QFD-PA programme.

8   In the implementation of QFD-PA project within the organisation, the opportunity of taking advantage of experts' opinion within the organisation must be utilised.

5.2   Implications

The managerial implications of the application of the QFD-PA framework presented in this study are many-sided, and are tied to the key benefits of the implementation of QFD-PA system. A key benefit is the opportunity to manage resources optimally. Since organisations are usually limited in resources, a focus on 'vital few' items that would bring about satisfaction of hotel guests is essential, and made possible by the QFD-PA framework. Thus, with limited budget, optimisation of financial resources could be attained without problems. This also leads to organised planning since stepwise utilisation of resources is required.

6   Conclusion

This study integrated PA with the QFD methodology to present a new approach for solving problems in hotels when choices among alternatives in a prioritised manner are desired. Focusing on a selected number of items gives management ample opportunities to synthesise the possible behaviour of some cost functions during planning. Consequently, this 'if-what' analysis becomes a strong feature for decision making and for winning funds when funds requirement proposals are submitted for project expansion.

Customer's satisfaction approach was used in determining the quality characteristics that meet customer's requirements, translating these characteristics into system requirements and specifying the CA that would provide better customer's service. The CA's were classified into three: the must-bes, one-dimensional and the attractors. The HOQ was developed and the system characteristics that will provide satisfaction were classified. The application of PA in tackling the prioritisation problem of QFD in

hotels offer a great challenge in view of the multiple number of items that may be considered. The causes of customer dissatisfaction in the hotel include the management insensitivity to customer complaints, its negative attitude towards quality service and preferential treatment for influential customers. A total of 27 CA's were identified that will increase customer satisfaction in the hotel.

It is recommended that a team of not more than five people should be constituted to carry out a QFD exercise at regular intervals with a view to improving customer services. The number is limited to five in view of the small size of the hotel used for the case study. Larger numbers could be chosen bearing in mind that the profit and size of the customers would be catered for. Also, a QFD exercise should be viewed as an investment rather than a cost-expense exercise. There should be an increase in top management commitment towards focusing on customer needs. In addition, subsequent customer service improvement exercises should gradually introduce the attractors in the hotel system.

Acknowledgements

References

Abdul-Rahman, H., Kwan, C.L. and Woods, P.C. (1999) 'Quality function deployment in construction design: application in low-cost housing design', *International Journal of Quality and Reliability Management*, Vol. 16, No. 6, pp.591–605.

Arditi, D. and Lee, D.E. (2003) 'Assessing the corporate service quality performance of design-build contractors using quality function deployment', *Construction Management and Economics*, Vol. 21, No. 2, pp.174–185.

Barnett, W.D. and Presley, A. (1998) *Quality Function Deployment for Designing the Virtual Enterprise*, Association for Information Systems (AIS'98), Baltimore, MD, Available at: http://www2.truman.edu/~apresley/ais98a.pdf, pp.559–561.

Barnett, W.D. and Raja, M.K. (1995) 'Application of QFD to the software development process', *International Journal of Quality and Reliability Management*, Vol. 12, No. 6, pp.24–42.

Bevilacqua, M., Ciarapica, F.E. and Giacchetta, G. (2006) 'A fuzzy-QFD approach to supplier selection', *Journal of Purchasing and Supply Management*, Vol. 12, No. 1, pp.14–27.

Bottani, E. and Rizzi, A. (2006) 'Strategic management of logistics service: a fuzzy QFD approach', *International Journal of Production Economics*, Vol. 103, No. 2, pp.585–599.

Büyüközkan, G., Feyzio lu, O. and Ruan, D. (2007) 'Fuzzy group decision-making to multiple preference formats in quality function deployment', *Computers in Industry*, Vol. 58, No. 5, pp.392–402.

Cagno, E. and Trucco, P. (2007) 'Integrated green and quality function deployment', *International Journal of Product Lifecycle Management*, Vol. 2, No.1, pp.64–83.

Chakraborty, S. and Dey, S. (2007) 'QFD-based expert system for non-traditional machining processes selection', *Expert Systems with Applications*, Vol. 32, No. 4, pp.1208–1217.

Chen, L.H. and Weng, M.C. (2006) 'An evaluation approach to engineering design in QFD processes using fuzzy goal programming models', *European Journal of Operational Research*, Vol. 172, No. 1, pp.230–248.

Chen, Y., Fung, R.Y. and Tang, J. (2006) 'Rating technical attributes in fuzzy QFD by integrating fuzzy weighted average method and fuzzy expected value operator', *European Journal of Operational Research*, Vol. 174, No. 3, pp.1553–1566.

Chiou, K. and Tong, L. (2001) 'Average type-II censoring times for two-parameter Pareto and rayleigh distributions', *International Journal of Quality and Reliability Management*, Vol. 18, No. 6, pp.643–657.

Craft, R.C. and Leake, C. (2002) 'The Pareto principle in organizational decision making', *Management Decision*, Vol. 40, No. 8, pp.729–733.

Dijkstra, L. and van der Bij, H. (2002) 'Quality function deployment in healthcare: methods for meeting customer requirements in redesign and renewal', *International Journal of Quality and Reliability Management*, Vol. 19, No. 1, pp.67–89.

Einspruch, E.M. (1996) 'Quality function deployment (QFD): application to rehabilitation services', *International Journal of Health Care Quality Assurance*, Vol. 9, No. 3, pp.41–46.

Foster, S.T. (2006) 'On horizontal deployment of quality approaches within a firm', *International Journal of Services and Operations Management*, Vol. 2, No. 2, pp.168–177.

Fung, R.Y., Chen, Y. and Tang, J. (2006) 'Estimating the functional relationships for quality function deployment under uncertainties', *Fuzzy Sets and Systems*, Vol. 157, No. 1, pp.98–120.

Gargione, L.A. (1999) 'Using quality function deployment (QFD) in the design phase of an apartment construction project', *Proceedings of the 7th International Conference on GLC*, University of California, Berkeley, CA, 26–28 July, pp.357–368.

Griffin, A. and Hauser, J.R. (1993) 'The voice of the customer', *Marketing Science*, Vol. 12, No. 1, pp.1–27.

Han, S.B., Chen, S.K., Ebrahimpour, M. and Sodhi, M.S. (2001) 'A conceptual QFD planning model', *International Journal of Quality and Reliability Management*, Vol. 18, No. 8, pp.796–812.

Hauser, J.R. and Clausing, D. (1988) 'The house of quality', *Harvard Business Review*, May–June, pp.63–73.

Herzwurm, G. and Schockert, S. (2003) 'The leading edge in QFD for software and electronic business', *International Journal of Quality and Reliability Management*, Vol. 20 No. 1, pp.36–55.

Hwarng, H.B. and Teo, C. (2001) 'Translating customers' voices into operations requirements – a QFD application in higher education', *International Journal of Quality and Reliability Management*, Vol. 18, No. 2, pp.195–226.

Islam, R., Ahmed, M. and Alias, M.H. (2007) 'Application of quality function deployment in redesigning website: a case study on TV3', *International Journal of Business Information Systems*, Vol. 2, No. 2, pp.195–216.

Kahraman, C., Ertay, T. and Büyüközkan, G. (2006) 'A fuzzy optimization model for QFD planning process using analytic network approach', *European Journal of Operational Research*, Vol. 171, No. 2, pp.390–411.

Kathawala, Y. and Motwani, J. (1994) 'Implementing quality function deployment: a systems approach', *The TQM Magazine*, Vol. 6, No. 6, pp.31–37.

Knights, P.F. (2001) 'Rethinking Pareto analysis: Maintenance applications of logarithmic scatterplots', *Journal of Quality in Maintenance Engineering*, Vol. 7, No. 4, pp.252–263.

Lee, T.R. and Lin, J.H. (2006) 'Utilising quality function deployment to select customer voice-based quality improvement technique for 3PL companies', *International Journal of Enterprise Network Management*, Vol. 1, No. 2, pp.179–195.

Maddux, G.A., Amos, R.W. and Wyskida, A.R. (1991) 'Organisations can apply quality function deployment as strategic planning tool', *Industrial Engineering*, September, pp.33–37.

Moores, B.M. (2006) 'Radiation safety management in health care – the application of quality function deployment', *Radiography*, Vol. 12, No. 4, pp.291–304.

258   *S.A. Oke et al.*

Orth, U.R. (2000) 'Quality function deployment: a means of integrating consumer expectations throughout cultivation systems', *Acta Horticulture (ISHS)*, Vol. 536, pp.607–612, Available at: http://www.actahort.org/books/536/536_73.htm.

Pitman, G., Motwani, J., Kumar, A. and Cheng, C.H. (1996) 'QFD application in an educational setting: a pilot field study', *International Journal of Quality and Reliability Management*, Vol. 13, No. 4, pp.99–108.

Pramod, V.R, Sampath, K., Devadasan, S.R., Raj, V.P. and Moorthy, G.D. (2007) 'Multicriteria decision making in maintenance quality function deployment through the analytical hierarchy process', *International Journal of Industrial and Systems Engineering*, Vol. 2, No. 4, pp.454–478.

Richardson, I. (1997) 'Quality function deployment - a software process tool?' *Third Annual International QFD Symposium*, Linkoping University, Linkoping, Sweden, 1–2 October.

Robaina, V.P. and Rodriguez, T.F. (2007) 'Identifying and determining the key processes for quality management systems in the hotel sector', *International Journal of Services Technology and Management*, Vol. 8, No. 6, pp.529–545.

Scheurell, D.M. (1994) 'Beyond the QFD house of quality: using the downstream matrices', *World Class Design to Manufacture*, Vol. 1, No. 2, pp.13–20.

Shin, J., Kim, K. and Chandra, M.J. (2002) 'Consistency check of a house of quality chart', *International Journal of Quality and Reliability Management*, Vol. 19, No. 4, pp.471–484.

Tan, K.C., Xie, M. and Chia, E. (1998) 'Quality function deployment and its use in designing information technology systems', *International Journal of Quality and Reliability Management*, Vol. 15, No. 6, pp.634–645.

Unal, R. and Dean, E.B. (1991) 'Taguchi approach to design optimization for quality and cost: an overview', *Proceedings of the 13th Annual Conference of the International Society of Parametric Analysts*, New Orleans, LA, 21–24 May.

Walker, M. (2002) 'Customer-driven breakthroughs using QFD and policy deployment', *Management Decision*, Vol. 40, No. 3, pp.248–256.

Wang, R.T. (2007) 'Improving service quality using quality function deployment: the air cargo sector of China airlines', *Journal of Air Transport Management*, Vol. 13, No. 4, pp.221–228.

Appendix

Table A1   List of customer *must-bes* and *attributes*

Department of Mechanical Engineering, University of Lagos, Nigeria

Dear respondents,

Please fill the questionnaire sincerely and as precisely as possible. Follow the instructions using the format stated. It is for research purpose

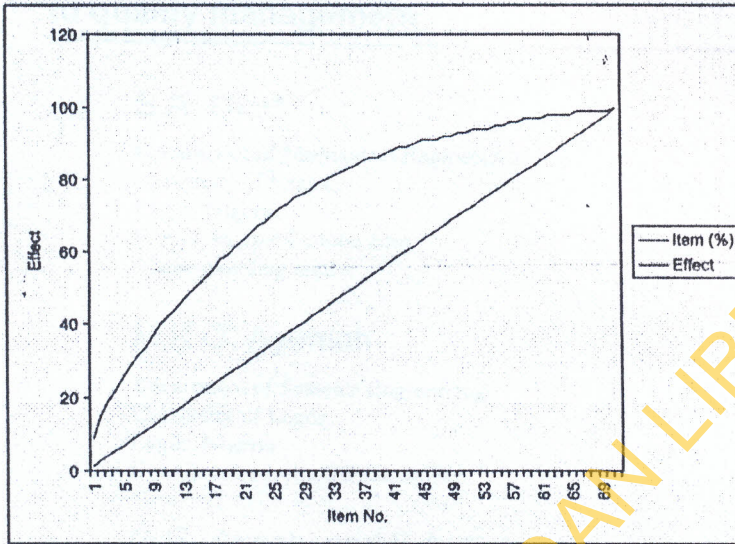| *Questionnaire to weigh customer attributes*						*Questionnaire for customer assessment rating*						
Key: 1 = Comfortable, 2 = Alright, 3 = Indifferent, 4 = I dislike it, 5 = I strongly dislike it Please tick						*Key: 1 = Very bad, 2 = Bad, 3 = Fair, 4 = Good, 5 = Very good Please tick*						
	1	*2*	*3*	*4*	*5*			*1*	*2*	*3*	*4*	*5*
1 How do you feel having room entertainment facility in the hotel?						1	Room entertainment					
2 How do you feel if the room in the hotel is cool?						2	Cool room					
3 How do you feel if the hotel room is well decorated?						3	Room decoration					
4 How do you feel with good bathroom amenities in the hotel?						4	Bathroom amenities					
5 If the hotel has a courtyard, how do you feel?						5	Courtyard					
6 How do you feel having water always in a hotel?						6	Water availability					
7 How do you feel viewing outside from your room's corridor?						7	Corridor view					
8 How do you feel about reservation in the hotel for your service?						8	Reservations booking					
9 If laundry is available in the hotel, how do you feel?						9	Laundry service					
10 If you can get messages in the hotel, how do you feel?						10	Message service					
11 How do you feel having secretarial services in the hotel?						11	Secretarial service					

	Key: 1 = Comfortable, 2 = Alright, 3 = Indifferent, 4 = I dislike it, 5 = I strongly dislike it Please tick	1	2	3	4	5		Key: 1 = Very bad, 2 = Bad, 3 = Fair, 4 = Good, 5 = Very good Please tick	1	2	3	4	5
12	If emergency maintained is available, how do you feel?						12	Car maintenance (emergency)					
13	How do you feel having conference room in the hotel?						13	Conference room					
14	How do you feel with a safe hotel environment?						14	Safe environment					
15	How do you feel if your life is safe in the hotel?						15	Safety of life					
16	How do you feel if your property is safe in the hotel?						16	Safety of property					
17	If meal is available every time, how do you feel?						17	Meal availability					
18	How do you feel with continental food availability in the hotel?						18	Free continental meal					
19	If the price charges are low, how do you feel?						19	Low price					
20	How do you feel having kitchen facilities in your room?						20	Kitchen facilities					
21	How do you feel about having an exercise room in the hotel?						21	Exercise room					
22	How do you feel if music room is available?						22	Music room					
23	If there is a sports hall in the hotel, how do you feel?						23	Sports hall					
24	How do you feel with a swimming pool in the hotel?						24	Swimming pool					
25	How do you feel with an appealing service?						25	General appeal					
26	How do you feel having a good atmosphere?						26	Atmosphere of hotel					
27	If there is food menu board, how do you feel?						27	Food menu					

Figure A1 QFD house of quality

	Group	Design Requirements
	LOCN	Good Atm. 5, Gen. App. 3
	LEISURE	Swim. pool 3, Sports hall 2, Music Room 2, Exercise Rm 2
	FOOD SER.	Kitchen Fac 3, Low Price 2, Free Cont. 3, Meal ava. 3
	SECUR.	Saf. of Pro 3, Saf. of life 5, Safe Envir. 5
	SERVICES	Conference 2, Car Mtce 2, Food Menu 5, Secret. Ser 3, Mess. Serv 2, Laundary 3, Reservatn. 3
	EX. FAC	Corridor Vi. 2, Water Av. 5, Courtyard 2
	ROOM	B.room Am 5, Decoration 3, Cool Room 3, Room Ent. 3

Item (%)	Absolute	CUSTOMER REQTS / DESIGN REQTS — IMPORTANCE
46.2	23	Tree Plant
37.8	33	Garden
26.6	42	Flowers
18.2	50	Reservoir(water)
23.8	45	Hotel Location
22.4	47	Sprinkler System
16.4	51	Balcony Shape
58.8	15	Window Shape
30.8	39	Reservation Desk
70	9	Pre-Credit Clearance
2.8	126	Bellman
57.4	15	Light on Phon
60.2	15	Note at Front desk
44.8	27	Message undre door
54.6	18	Client drop off & pick up
4.2	84	Information Board
84	9	Photographing Machine
67.2	9	Typewritter
68.6	9	Typist
88.2	6	Mechanic
100	2	Hotel Driver
61.6	15	Screen Projector
19.6	48	Lighting Style
28	42	Conference chair
51.8	20	Hotel Car
86.8	6	Microphon at Each desk
65.8	9	Colour T.V
71.4	9	Colour T.V./ Channel
72.8	9	Video Player
74.2	9	Rental Cassette
56	15	C D Player
95.2	3	Sound Proof Walls
32.2	38	Air Conditioner
1.4	194	Generator
96.6	3	Indirect Lighting
75.6	9	Household Supplier
77	9	Std. Size Sink
49	27	Quiet bar lounge
40.6	27	Magazine
93.8	5	Sofa
53.2	18	Background Music
25.2	45	Hotel Guest & Friends
78.4	9	Restaurants in Hotel
79.8	9	Restaurant near by
81.2	9	Full Service Rest (Food Menu: 81)
29.4	42	Meal Sale Price (Food Menu: 29)
82.6	9	Fast Food
36.4	33	Quantity of Food
89.6	6	Walter
43.4	27	Food stuff
85.4	9	Snack bar
42	27	Phone in order
47.6	21	Cook
35	36	Refrigerator
91	6	Night Singer
92.4	6	Musical Instrment
63	12	Training Weight
64.8	12	Running Machine.
8.4	66	Trainer
33.6	36	Table tennis Facilities
50.4	20	Computer games
15.4	51	Sport Shop
21	47	Smoke Detector
5.6	75	12hrs video camera
14	54	Fire Alarm (Car Mtce: 14)
98	2	Parking area Attendant
12.6	59	Check In/out system
11.2	60	Security guard
39.2	30	Security Light (Car Mtce: 39)
7	69	Fire Extingusher
9.8	61	Lighting Protector

Total absolute scores = 2137

RELATIONSHIP: 1 ◁ Weak   3 ◆ Medium   9 ■ Strong

Figure A2   Pareto analysis showing effect