Application of Quality Function Deployment To Improve Customer Satisfaction In Hotel Industry

(A case study in a 5-star Hotel)

Praveen Shrivastava, Dr Devendra S. Verma

Abstract— Satisfying customers is usually pursued by identifying their needs and translating their demands into design targets and thereby assessing the implementation of improvements on a continuous basis in order to attain the set targets. Quality function deployment is a planning tool used to fulfill customer expectations and in-depth evaluation of a product. The presented research aimed to get QFD model to improve service quality using customer needs priorities in a 5-star hotel of Indore. In the research customer satisfaction and importance degree of each need is investigated using survey method. Information was collected from the customers, employees and managers of the hotel to determine the factors affecting the customer satisfaction. After identifying the factors one questionnaire was given to the customers to rank their satisfaction received from the hotel. Selected sample size of the customers was 150. QFD team consisted of 5 managers and senior employees whose opinions were considered to determine the technical requirements to fulfill customer demands. Inter relationship matrix was constructed to evaluate the relationship between voice of customers and technical requirements. Co relationship matrix constructed to show the relationship among the technical requirements. Then customer competitive evaluation was done and finally competitive technical analysis was done to evaluate the degree of efforts by competitors to achieve customer satisfaction. Final results show that from view point of customers making bills correctly, Personal attention, Clean rooms, qualified food, Professional staff and affordable price are more important.

Key words – Quality Function Deployment, Voice of customer, House of Quality, Planning Matrix, Relationship Matrix, Co relationship matrix, Customer competitive evaluation, and Competitive technical analysis.

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1 INTRODUCTION

Quality function deployment (QFD) is a comprehensive quality system used to achieve customer satisfaction and business growth in almost all types of industries like Hotel industry, Manufacturing industry, Ship building industry, Automobile industry, product design, product service, project management and after sales service etc. Quality Function Deployment has achieved remarkable popularity around the world in a wide variety of service sectors. QFD identify the flaws and bridge the gap between present level and standard level of Technical requirements then leads to invent and deploy better quality of services. QFD improves the number of satisfied customers in the business which leads to higher profit generation and Business growth. Consequently brand name and goodwill of the particular industry improve among their competitors.

In Akao's words, QFD "is a method for developing a design quality aimed at satisfying the consumer and then translating the consumer's demand into design targets and major quality assurance points to be used throughout the production phase. QFD is a way to assure the design quality while the product is still in the design stage." As a very important side benefit he points out that, when appropriately applied, QFD has demonstrated the reduction of development time by one-half to one-third [3].

Initiated by Shigeru Mizuno and Yoji Akao [7] of the Tokyo Institute of Technology in the 1960s, the QFD process was first applied at Mitsubishi Heavy Industries Limited in the Kobe Shipyard, Japan, in 1972. QFD became popular in North America, starting with renowned multinational companies such as General Motors, Ford, Xerox etc, then it spread all over the world and successfully implemented in variety of sectors like Hamden Bin Mohammed e-University Academic City Dubai, Carl-son Hotels in the Asia Pacific, and 24 story high rise 5-star Hyatt Hotel in Tehran.

The Ritz-Carlton Hotel implemented QFD and win the Malcolm Baldrige National Quality Award in 1992 and 1999 [7]. Azadi Grand Hotel (Hyatt hotel), 4- star hotel in Zanjan, Sheraton Hotel, Carlson Hotels in the Asia Pacific achieved customer satisfaction, employee engagement, and quality assurance standards. Consequently boost their return rates.

U.S. car manufacturers of the late 1980s to early 1990s need an average of five years to put a product on the market, from drawing board to showroom, whereas Honda can put a new product on the market in two and a half years and Toyota does it in three years. Both organizations credit this reduced time to the use of QFD [19].

2 Related Works

Implementation of QFD resulted in better customer satisfaction in "4- star hotel in Zanjan". In the research customers` satisfaction of the services and importance degree of each need was investigated using survey method. Information was collected from two different community and samples. The first statistical community were the customers, employees and

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managers of Zanjan`s grand hotel that whom were needs-assessed to determine the factors affecting customer satisfaction. Second statistical community or better said, decision team consisted of 4 managers and senior employees of the hotel whose opinions were applied when completing the "House of Quality". The results shows that from the view point of customers, offering qualified food, existence of sauna and swimming pool, friendly behavior and attitude of personnel and their proper appearance are more important [5].

"Kazakhstan Institute of Management, Economic & Strategic Research (KIMEP)"Implemented Quality Function Deployment to improved the standards of management education. The "House of Quality (HOQ)" illustrates the transformation process from student requirements to instructional development. The QFD data analysis suggests that the curriculum needs restructuring. The number of tutorial sessions needs more time; exam needs restructuring, while the weight of the quizzes should be increased. The technical resources are necessary to deliver courses effectively. Most of the students in discipline felt the need of qualified instructors with pedagogical skills and business experience [6].

A case study in "Azadi Grand" 24 story high rise four-star Hotel, was developed to achieve the standards of Five-star hotel. QFD is a profitable tool for the service industry, specifically for the hospitality industry. Main contribution of the research was the development and implementation of a three-phase action plan based on the entire QFD methodology for a hotel. Derived action plans have been performed based on the recommended target values for the hotel. Results show that the QFD methodology improved the level of services to match with the standard of "5- star Hotel" also resulted in better customer satisfaction [7].

"HOST MARRIOT" Food Company implemented QFD to increase the sales more than double in a year. HOST Food Company having $ 1.2 billion sales per year with 170 locations worldwide. Host has 2000 outlets worldwide. They could improve the food quality consequently enhanced customer satisfaction and profit generation. Results show that within two weeks sales were up 50%, and after one year sales double their previous year's level [8].

"Toyota & Honda" motor cars implemented QFD as a tool for improvement of car dashboard. They used survey to employees and Customers, categorized their priorities, setting important ratings then prepared the "house of quality model". A questionnaire is used for getting 'Voice of the Customer' (VOC). 'Voice of the Customer' is translated into customer needs Which are then converted into technical specifications. The output from House of Quality (HOQ) is used in concept generation. Pugh chart is used for concept selection. Two important developments, in the car dashboard, the forced exhaust system and the multipurpose cup holder are made according to the customer's expectations [9].

"Hamden Bin Mohammed e-University, Academic City Dubai" implemented QFD for assessing and evaluating the higher education management program cycle. The proposed Quality Function Deployment educational program assessment process is a comprehensive quality governance system that systematically links program outcomes, course outcomes, course assessments, student evaluations and faculty evaluations to ensure complete alignment toward achieving the set Program Goals, overall institutional outcomes and the University's mission. The Quality Function Deployment is applied at two stages: Stage 1, where each course's goals and outcomes are related with the program goals and institutional learning outcomes, and Stage 2, where actual end-of-the-semester data from student assessments and faculty evaluations are collected and fed to the Quality Function Deployment system. Overall evaluation results show that the Quality Function Deployment education governance system has successfully identified the relative strengths and weaknesses in meeting Program Goals, Program Outcomes, and Course Outcomes. The results of this exercise can be used to evaluate the effectiveness of the program's yearly cycle and to devise appropriate interventions for improving the program and course design and delivery strategies [12].

Implementation of Quality Function Deployment made the process of new product development more reliable, easy and efficient for world's top notch companies. The presented paper provides ample examples for the functional fields like Product development, Quality management, Customer needs analysis, Product design, Planning, Engineering, Decision-making and Management. Various references are quoted for applied industries of QFD like Transportation and communication, Shipbuilding, Electronics and electrical utilities, Software systems, computer-integrated manufacturing, Services, Education and research, research program design, and Other industries like construction, disaster prevention, environment protection etc. [13].

3 PROPOSED WORK & DESIGN FLOW

The methodology adopted in this research work is to develop the "House of Quality" model. We have six main steps:

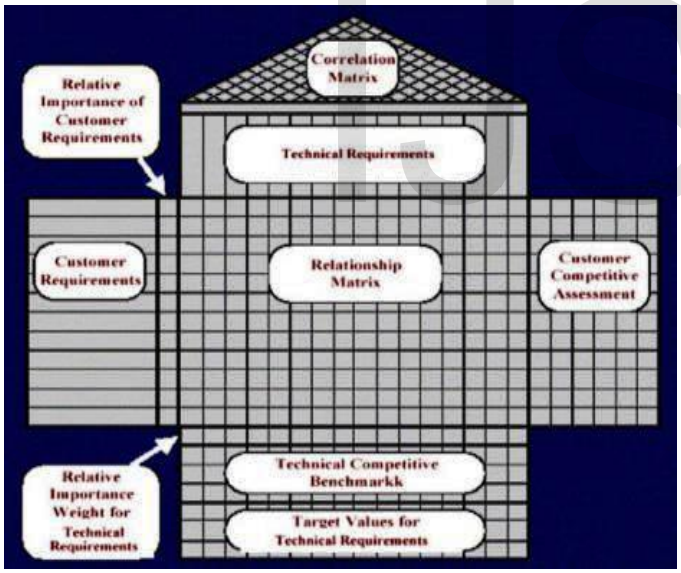
Customer Requirements (V.O.C)
Technical Requirements (T.R)
Relationship Matrix
Correlation ship Matrix
Customer Competitive Evaluation (CCE)
Competitive Technical Analysis (CTA).

The Absolute Weights and Relative weights helped analyze specifically the importance of each quality and how much effort would take in order to improve upon it. It can be used to allocate assets and staff accordingly where and when it is needed.

3.1 Process for Development of House of Quality

a). Collect the Customer demands, importance ratings & competitor ratings.
b). Construct customer requirements portion of matrix (Horizontal).
c). Construct technical requirements portion of matrix (Vertical).
d). Construct Relationship matrix Between VOC and Technical Requirements (Central portion).
e). Construct correlation matrix (Triangular shaped Roof of house of quality).
f). Find the Absolute weight, Relative weights and Organizational difficulties to achieve required level of services and technical analysis of competitor's products.

3.2 House of Quality Model (Figure)



4 SYMBOLS USED

4.1 For Relationship matrix

Θ – 9 (Strong relationship)
O – 3 (Moderate relationship)
Δ – 1 (Weak relationship.)

4.2 For Co-relationship matrix

O – Positive relationship
X – Negative relationship.

4.3 For Direction of improvement of Technical Requirements (T.R)

O - Meeting Target,
↑ - Maximize,
↓ - minimize

4.4 Graphical Symbols For Customer Competitive Evaluation & Competitive Technical Analysis

Orange color line – Hotel in consideration

Green color line – competitor A

Light blue color line – competitor B.

4.5 Formula Used

Relative weight = (weight of importance of particular VOC/ Total sum of weight of importance) * 100
Absolute weights = Total sum of (Weight of importance * relationship value of the corresponding cell).

5 CASE STUDY

The presented research aimed to get "QFD model" to improve service quality using customers` needs priorities in terms of case study in a 5- star hotel of Indore. In this paper A "HOQ matrix" was developed to identify customer wants and product attributes needed to satisfy customer requirements .

5.1 Customers: We have taken the regular visitors, businessman and professionals, gender wise both male and female.

5.2 Sample size: Selected the appropriate sampling method and sample size. We used simple random sampling and sample size is 150.

5.3 Questionnaire to collect Voice of customers: Words used by the customers to describe their expectations are often referred to as the voice of the customer. Sources for determining customer expectations are focus groups, surveys, complaints, consultants, standards, and federal regulations. During the collection of information, the QFD team must continually ask and answer numerous questions, such as
1. What does the customer really want?
2. What are the customer's expectations?
3. What can the design team do to achieve customer satisfaction?
We Prepared a Questionnaire by considering all types of demands like spoken, unspoken and implied demands.

5.4 Type of survey: Collect the "voice of customers (VOC)" by using the various methods of primary data collection like per-

sonal interview, Telephonic interview and E-mails. We have collected the voice of customers (VOC) through personal interview, Telephonic interview and E-mails.

5.5 Type of responses : It can be collected on "Likert scale" (5 point scale, 7 point or 9 point scale) from strongly disagree to strongly agree on a particular question. We used Likert scale (5 point scale) from strongly disagree on a given question is given as number 1 and strongly agree is given as number 5.

6 ANALYSIS

6.1 Voice of Customer & Importance degree: First prepared the questionnaire and collected the Voice of customer (Response of customers) for sample size of 150 selected customers on 5-point likert scale. Thereafter Relative Weights for each VOC are calculated by taking percentage out of total score of weights. Relative weights are calculated for each voice of customer by the formula given: Relative weight = (weight of importance of particular VOC/ Total sum of weight of importance) * 100. Then Voice of customers are placed priority wise On the basis of Relative Weights. Like for VOC: "Making bills and reports correctly" Like relative weight is = (10.8 / 214.74) *100 = 5.03 which is highest so it is ranked 1st and placed at first position whereas for VOC: "Fulfilling the required services at first request" Relative Weight is lowest (4.14) so it is ranked 21st. and placed at the last position.

6.2 Planning Matrix**:** Weight of importance is calculated for surveying company and both the competitors, Competitor A and Competitor B. Then Relative weights are calculated for each company by applying the formula: Relative weight = (weight of importance of particular VOC/ Total sum of weight of importance) * 100. Like Relative weight for first VOC, surveying company is 4.59 taken as 5 as it is above 4.5 whereas Competitor A got 3.35 taken as 3 as it is below 3.5 and Competitor B got 2.27 taken as 2 as it is below 2.5. Similarly relative weights are calculated for each voice of customer (from 1 to 21) for all the competitors.

6.3 Customer Competitive Evaluation: The evaluation shows the opinion and satisfaction of customers for a particular VOC for different competitors. Results of customer competitive evaluation are depicted by graph. Orange color line shows "Hotel in consideration", Green color line shows "competitor A" and light blue color line shows "competitor B". Evaluation shows the leading and lagging position for competitors for a particular VOC. it shows the direction of corrective measures a company will take to satisfy the demands of the customers.

6.4 Relationship Matrix **:** Technical requirements are collected by the discussion with management of each company. Then we established the inter relationships between Voice of customer (VOC) and technical requirements (TR). For each V.O.C there should be some relationship with given technical requirements. Those relationships are depicted by the symbols like;

Θ – 9 (Strong relationship)
O – 3 (Moderate relationship)
Δ – 1 (Weak relationship)

6.5 Co-relationship matrix**:** We established the relationship of one Technical requirement with another Technical Requirements. That improving a particular technical requirement will cause to improve or decline the other technical requirements. Here these relationships are shown with the help of symbols like:

O – Positive relationship
X – Negative relationship.

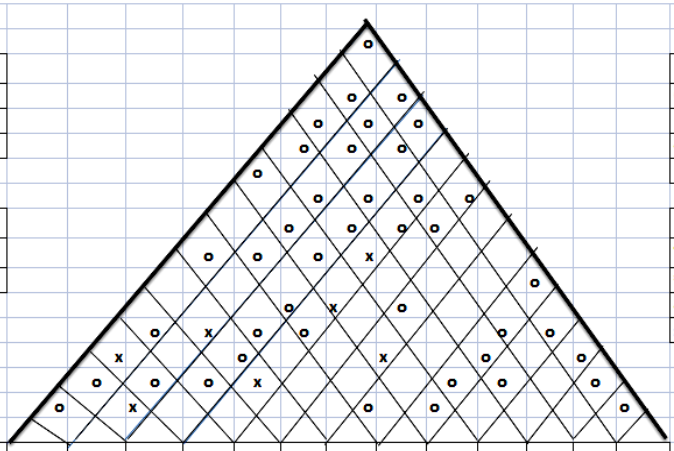
6.6 Technical Properties **:** First "Absolute weights" are calculated for each Technical requirement by the formula: "Weight of importance is multiplied with relationship value of the corresponding cell then all the values are added". It gives the absolute weight for that particular VOC. Like for first Technical requirement Absolute Weight = (10.8*9+10.69*1+10.68*1+10.6*3+10.59*3+10.56*3+10.53*3+10.52*3+10.46*1+10.36*3+10.26*9+10.24*1+10.06*1+10.05*3+10.03*1+9.98*3+9.97*3+9.88*1+9.86*3+9.73*1+8.89*3) = 607.40.
Similarly Absolute Weights for each technical requirement is calculated and recorded under the corresponding columns. Thereafter "Relative weights" are calculated for each technical requirement by the same formula given in 6.1.

6.7 Competitive Technical Analysis**:** This analysis shows which company or competitor is better in adapting the correct technical measures to satisfy the customer demands. It shows the strength and weakness of a particular company or competitor which can be improved by implementing the suitable methods to achieve the better satisfaction of customers and business growth. Orange color line shows "Hotel in consideration", Green color line shows "competitor A" and light blue color line shows "competitor B". Upward arrow shows the direction of betterment of technical efforts for each competitor.

Finally we have constructed the customer requirements portion of matrix (Horizontal), technical requirements portion of matrix (Vertical), Relationship matrix Between VOC and Technical Requirements (Central portion), correlation matrix (Triangular shaped Roof of house of quality) and hereby House of quality is developed. Analysis is done for Customer competitive Evaluation and Competitive Technical Analysis with the help of Technical Properties.

7 DEVELOPED HOUSE OF QUALITY MODEL

House of Quality



Relationship Key:	
Θ	Strong
O	Moderate
Δ	Weak

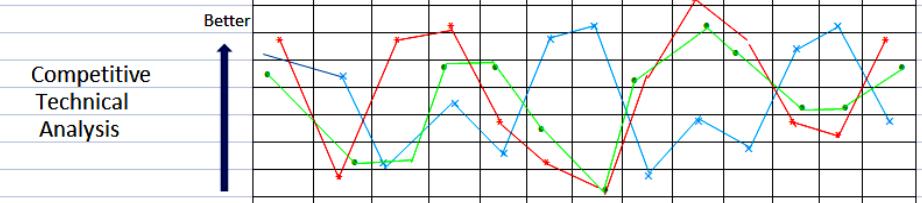
Co-relationship key :	
o	Positive
x	Negative

Key for Customer Compititive Evaluation :
* Surveying Company
• Compititor A
× Compititor B

Key for Competitive Technical Analysis :
* Surveying Company
• Compititor A
× Compititor B

Coloumn	1	2	3	4	5	6	7	8	9	10	11	12	13
Direction of improvement : O - Meeting Target, ↑ - Maximize, ↓ - minimize	O	↑	O	O	↑	↑	↑	↑	O	O	↑	↑	O

Row	Technical requirements → / Customer requirements ↓	Reliable services	Proper maintenance	Qualified staff	Prompt service	Security staff	Politeness & Humble	Cost management system	Online reservation policy	Housekeeping staff	Food & Beverage staff	Health facilities	IT services	24- hour services	VOC Weight of importance	VOC relative weight	Customer Compititive Evaluation 1	2	3	4	5
1	Making bills and reports correctly	Θ	Δ	O	Δ	Δ	Δ	O	Δ	Δ	Δ	Δ	Δ	Δ	10.8	5.03					
2	Personal attension to all the customers	Δ	Δ	O	O	Δ	Θ	Δ	Δ	Δ	O	Δ	Δ	O	10.69	4.98					
3	Well dressed and professional staff	Δ	Δ	Θ	Δ	Δ	Δ	Δ	Δ	O	Δ	Δ	Δ	Δ	10.68	4.97					
4	Qualified food and beverages	O	Δ	O	Δ	Δ	Δ	Δ	Δ	Δ	Θ	Δ	Δ	Δ	10.6	4.94					
5	Clean and tidy rooms	O	Δ	O	Δ	Δ	Δ	Δ	Δ	Θ	Δ	Δ	Δ	Θ	10.59	4.93					
6	Fast reservation and settlement scheme	O	Δ	O	Θ	Δ	Δ	Δ	Θ	Δ	Δ	Δ	O	O	10.56	4.92					
7	Equipments are always functioning	O	Θ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	O	O	Δ	10.53	4.9					
8	Personnel's interest to help the customers	O	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Θ	O	10.52	4.9					
9	Compititive and afordable price	Δ	Δ	Δ	Δ	Δ	Δ	Θ	Δ	Δ	Δ	Δ	Δ	Δ	10.46	4.87					
10	Friendly atitude of personnel towards customer	O	Δ	Δ	Δ	Δ	Θ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	10.36	4.82					
11	Providing services as promised	Θ	O	Δ	O	Δ	Δ	Δ	O	O	Δ	O	O	O	10.26	4.78					
12	Visually appealing facilities	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Θ	Δ	Δ	Δ	Δ	10.24	4.77					
13	Proper location of the hotel	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	O	10.06	4.68					
14	Facilities of swimming pool , sauna and zacuzzi	O	O	Δ	Δ	Δ	Δ	Δ	Δ	O	Δ	Θ	Δ	Δ	10.05	4.68					
15	Proper internet accessibility in rooms	Δ	Δ	O	Δ	Δ	Θ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	10.03	4.67					
16	Safe environment for acomodation	O	Δ	Δ	Δ	Θ	O	Δ	Δ	Δ	Δ	Δ	Δ	O	9.98	4.65					
17	Personnel's knowledge to answer the customers	O	Δ	Θ	Δ	Δ	Δ	Δ	Δ	Δ	Θ	O	Δ	Δ	9.97	4.64					
18	Providing fast services to the customers	Δ	Δ	Δ	Θ	Δ	Δ	Δ	O	O	Δ	Δ	Δ	Δ	9.88	4.6					
19	Proper working time for the customers	O	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Θ	9.86	4.59					
20	Understanding special needs of the customers	Δ	Δ	O	Δ	Δ	O	Δ	Δ	O	O	O	Δ	Δ	9.73	4.53					
21	Fulfilling the required services at first request	O	Δ	Δ	Θ	Δ	Δ	Δ	O	O	Δ	Δ	Δ	O	8.89	4.14					
	Technical Difficulty	13	9	12	5	8	4	6	1	2	10	7	3	11							



Our Company	10.79	6.04	9.37	8.80	5.28	8.90	5.61	6.27	8.96	7.49	6.79	6.39	9.30
Compititor A	10.73	6.06	9.23	8.75	5.50	9.05	5.60	6.26	8.91	7.45	6.80	6.43	9.24
Compititor B	10.76	6.22	9.23	8.67	5.14	9.39	5.90	6.09	8.75	7.30	6.87	6.54	9.14
Absolute Weight	607.40	339.60	525.94	491.3	294.6	503	320	357.3	500.4	420.1	376.1	362	520.3
Relative Weight	10.81	6.05	9.36	8.75	5.24	8.95	5.70	6.36	8.91	7.48	6.70	6.44	9.26

8 CONCLUSION

The presented research aimed to get QFD model to improve service quality using customer's needs priorities in terms of case study in a 5 star hotel of Indore. The results shows that from the view point of customers, Making bills and reports correctly, Personal attention to all the customers, Well dressed and professional staff, Qualified food and beverages, Clean and tidy rooms, Competitive and affordable price are more important. "Hotel in consideration" is leading in these areas for achieving customer satisfaction among other competitors.

By the analysis of "Competitive Technical analysis" we conclude that "Hotel in consideration" is leading in "Technical requirements (T.R)" like Reliable services, Qualified staff, Prompt services, Housekeeping, On line reservation policy, Food & Beverage staff and 24-hour services. So no need to increase the level of services for these technical measures, it will save cost, manpower, time and resources of the company.

Whereas For "Technical requirements (T.R)" like Proper maintenance of equipments, Health facilities and security staff "Hotel in consideration" is meeting the target values, though in these areas improvement is not a necessity yet slight improvement will maintain the leadership of the hotel in the future.

But there are three "Technical requirements (T.R)" like Politeness & humbleness, Cost Management System and IT services where "Hotel in consideration" is lagging behind the competitors in service standards. So in these three areas hotel in considerateon has to analyze the Technical measures, Inter relationship and Co-relationship to find out the gap between present level and standard level of services. This analysis will guide them to allocate the required resources like manpower, methods, finance, equipments, technology and system in these areas. It will lead to achieve better customer satisfaction and full hold of leadership in all aspects. Consequently higher profit generation and better goodwill of the hotel can be achieved. Our presented research can be successfully used to achieve higher standards of services and customer satisfaction for different star rating hotels.

9 REFERENCES

[1] A. Terry Bahill, William L. Chapman (1993), "A tutorial on Quality Function Deployment", Engineering Management Journal Vol. 5 No. 3.

[2] AUT University. "Quality Function Deployment" <http://www.ciri.org.nz/downloads/Quality%20Function%20Deployment.pdf>

[3] Chan, L.K. and Wu, M.L. (2002), "Quality function deployment: a comprehensive review of its concepts and methods", Quality Engineering, Vol. 15 No. 1, pp. 23-35.

[4] Chin, K.S., Pun, K.F., Leung, M.W. and Lau, H. (2001), A quality function deployment approach for improving technical library and information services: a case study, Library Management, Vol. 22 No. 4/5, pp 195-204.

[5] Davood Gharakhani, Javed Eslami (2012), "Determining customer needs priorities for improving service quality using QFD", International Journal of Economics and Management Sciences Vol. 1, No. 6, pp. 21-28.

[6] Dr. Shamsuddin Ahmed, (2006), "QFD Application to improve Management Education at KIMEP". Issues in Information Systems, Volume VII, No. 1.

[7] Kioumars Paryani & Elizabeth A. Cudney (2010). "QFD Application in the Hospitality Industry: A Hotel Case Study". QMJ, VOL. 17, no. 1, AS Q.

[8] Glenn H Mazur, Executive Director at QFD Institute, "Doubling sales with Quality Function Deployment". <www.mazur.net/works/bagel_qfd_at_host_serv_asqc97.pdf >

[9] Hamidullah, R. Akbar, S. Noor, W. Shah & Inayuatullah (2010), "a tool for improvement in car dash board", Journal of Quality and Technology Management Volume VI, Issue 1, pg. 1 – 22.

[10] Hauser, J. R. and D. Clausing (1988). "The House of Quality," The Harvard Business Review, May-June, No. 3, pp. 63-73.

[11] Jennifer Tapke, Allyson Muller, Greg Johnson and Josh Seick, "Steps in Understanding the House of Quality". <www.public.iastate.edu/~vardeman/IE361/f01mini/johnson.pdf>

[12] Khalid Hafeez, Abdelkader Mazouz (2011), "Using Quality Function Deployment as a higher education management and governance tool", Verslo ir teisės aktualijos, 6(1), 31–52

[13] Lai-Kow Chan, Ming-Lu W (2002), "Quality function deployment: A literature review", European Journal of Operational Research (ELSEVIER) 143, 463–497.

[14] Mayank Maewall, Patrick Dumas (2012), "Quality Function Deployment: Healthcare Improvement Worcester Polytechnic Institute (USA)". <www.wpi.edu/Pubs/E-project/Available/E.../QFD_Final_Report2.pdf>

[15] Mazur, G.H. (2008), "Delighting customers with quality function deployment: voice of customer meets voice of process", Transactions from the 14th International Symposium on Quality Function Deployment, QFD Institute, Ann Arbor, MI. <www.mazur.net/mazur_presentations.htm >

[16] MBA Luis Bernal, Dr. Utz Dornberger (2009), "Quality Function Deployment for services", International SEPT Program, Germany. <http://www.vgu.edu.vn/fileadmin/pictures/studies/MBA/Handbook_QFD_Services.pdf>

[17] Sunday Ayoola Oke (2013), "Manufacturing Quality Function Deployment: Literature Review and Future Trends", Engineering Journal Volume 17, Issue 3.

[18] Yoji Akao (1997), "QFD: Past, Present, and Future", International Symposium on QFD '97–Linkoping. <intra.itiltd-india.com/quality/qulandreltools/qfd_history.pdf>

[19] "Quality Function Deployment (QFD)", Chapter 11 pp. 259-295.<www.eng.usf.edu/~besterfi/class/capDOCS/**qfd**.doc>

[20]Tuli Bakshi, B. Sarkar and S. K. Sanyal (2012), "An Optimal Soft Computing Based AHP-QFD Model Using Goal Programming for Decision Support System", International Journal of Scientific & Engineering Research, Volume 3, Issue 6.