

QFD as a tool for Improvement of master bathroom

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ABSTRACT

Today's customers are quality concerned. In the present era, master bathroom are need of every house-hold and family which are made for well-planned spacious houses. The master bathroom has spaces saving bathroom designs which are effective for present needs, have sufficient sunlight as well as ventilated and comfortable with space presently available. The customers drive service providers have to add value and, proper care has been given to grab their reactions and the requirements which have been put into the HOQ (House of Quality) that ultimately gives us the solution. Using the QFD house of quality model, it was able to understand the fundamental and basic requirements of customers and quality and care for basic requirements within the real estate. This paper represent a simple case using QFD from the design phase of a real estate construction project as a tool for improvement in master bathroom unit feature. The main purpose of QFD in the study was to apply customer oriented design in construction and a method which can be used in any industries in services or manufacturing, and to adopt the tables and matrix as used in QFD. From the result of master bathroom by QFD applications to short out the basic parameters which are needed to modify, according to voice of customer and the results are used for new generalized design.

Keywords: Quality function deployment, Master bathroom, House of quality, Multiutility.

1. INTRODUCTION

Now a day's master bathrooms are essential not only for luxury but also a necessity of daily life. Master bathroom is an important part of the house interior, so can be used to play different routine works in daily life. Common functions for which the master bathroom are employed: toilet, bath tub, washbasins, and shower, geyser and to store bathroom accessories. Master bathroom should not only aesthetic but also quite practical and handy, especially for the contemporary families. Decorating the master bathroom will no longer be a difficult and time consuming task. Master bathroom to be installed in homes of not only the high segment customers but also the middle class and the average customers. India has a diverse population and most of the people live on rent but their choice is for master bathroom [17].

2. HISTORY OF QUALITY FUNCTION DEPLOYMENT

QFD was developed by Yoji Akao in Japan in 1966. By 1972 the power approach had been well demonstrated at the Mitsubishi heavy industries Kobe shipyard (Sullivan, 1986) and in 1978 the first book on the subject was published in Japanese and later translated into English in 1994 (Mizuno and Akao 1994) [11]. QFD (quality function deployment) is defined as a method for developing a design quality aiming 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[4]. QFD can be seen as a process where the consumer's voice is valued to carry through the whole process of production and services. In figure-1, the house of the quality is most commonly used matrix in QFD. It is the first matrix in QFD's four phase approach. Its purpose is to translate important customer requirement regarding product quality into important end product quality characteristics. House of quality include the following components: an objective statement, voice of the customer, importance rating, competitive assessment, and voice of supplier, target value, correlation matrix, relationship matrix absolute score and relative score[4]. Quality function deployment (QFD) is a well-known method that is powerful in designing high quality services (Mazur, 2008). A significant number of QFD successful applications in the service sector have been reported, including service areas such as education (Koksal and Egitman, 1998; Lam and Zhao, 1998), technical libraries and information services (Chin et al., 2001), public sector (Gerst, 2004), e-banking (Gonzalez et al., 2004), spectator events (Enriquez et al., 2004), hospitality (Stuart and Tax, 1996). QFD is a technique used in more proactive product development and quality improvement in many fields (Tan and Shen, 2000). QFD technique investigates customer requirements in intensive detail and enables organizations to outperform effective competitive strategies. Hence, QFD is a customer-driven quality management system (Kaulio, 1998) aiming to create higher customer satisfaction [19].

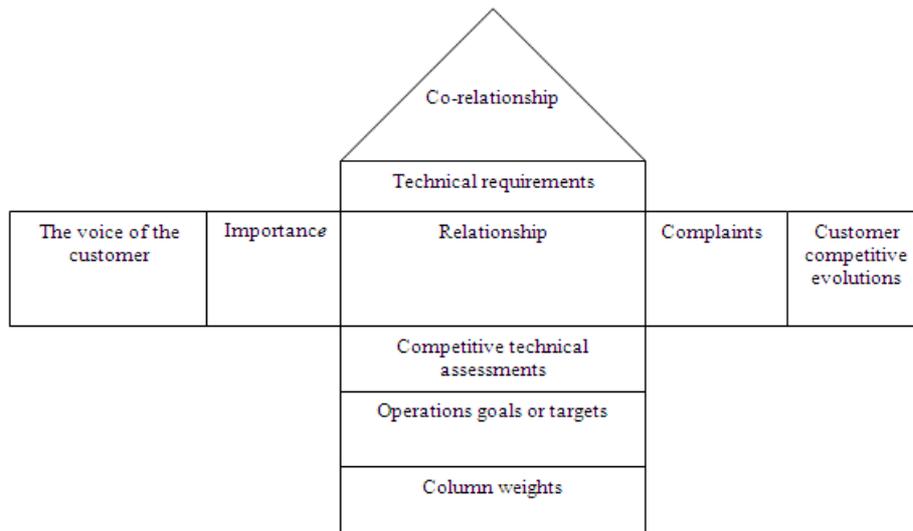


Figure-1: The basic elements of the QFD

Case Study: These case studies apply QFD in the design improvement of master bathroom located on an urban area of Indore city in India. The construction area was approximate 14’ X 6’ (84 Sq. Feet.) The estimate budget for this project was around Rs 1.25 Lac.

3.METHODOLOGY

QFD is essentially a process where customers’ voice is translated into design attributes. A typical QFD process has four successive phases as depicted in Figure 2.

1. **Product planning:** This phase begins with customer requirements. A set of design requirements is determined, which, if satisfied, will result in achieving customer requirements.
2. **Product development:** It involves design /redesign and fabrication of new or modified product and then testing it to find its usefulness. Product development is essential in order to meet changing consumer needs, maintain sales position and profit margin etc. The various steps involved in developing a product are given below:
 - a. get new ideas
 - b. evaluate ideas technically
 - c. evaluate ideas from market’s point of view
 - d. take the final decision
 - e. get into production and
 - f. introduce product into the market

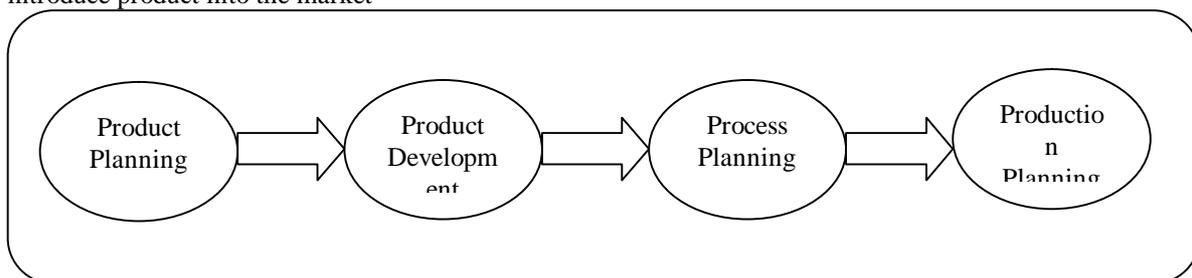


Figure-2: QFD methodology flow

3. **Process planning:** Process planning is the systematic determination of the methods by which a product is to be manufactured economically and competitively. When a product is designed, certain specifications are established; physical dimensions, tolerances, standards, and quality are set forth. Then it becomes a matter of deciding the specific details of how to achieve the desired output. This decision is the essence of process planning.
4. **Production planning:** Finally, production requirements are determined from key process operation. This phase ends with prototyping and production launch [7].

The sequence of preparing the product planning matrix is as follows:

1. **Identification and definition of product:** The concept of QFD is used for master bathroom. These projects apply QFD in the design and development improvement of master bathroom. It is decided to take into account three of the leading builder’s house unit as per their current market. These three competitors are code named as A, B and C for practical convenience. Data collection through questionnaire based interview and literature study formed the

basis of the whole exercise. The first technique adopts interviews with sale person who has a strong relationship with buyer and users. Another technique are used “Focus Group” approach using mid sized and small sized groups, obtaining information through questions and benchmarking between different projects in order to find out likes, dislikes, trends and opinion about similar current and other projects. Different people including real estate agents, architect, engineers, potential buyers and owners of similar master bathroom composed the focus groups. Around 75 persons are taken as sampling units.

2. Determine the customer requirements: For the purpose of gathering data, house users and potential users are targeted. A mix mode, structure and non structured questionnaire are administered which include questions on their needs and expected from the master bathroom. Along with this a number of master bathrooms related case study and research paper are also referred. Ten parameters are finally considered combining the essence of whole gamut of user’s requirements in the table-1.

Table-1: Customer Requirements

S. No.	Customer Requirements
1	Natural light & ventilation
2	A sink
3	Water heater
4	One toilet
5	Bath tub
6	Large counter top durable material
7	Flooring in the bathroom
8	Toilet wall tiles
9	Toilet door easy to clean – smooth
10	Shower

3. Determine of Priority rating: In the table-2, the importance rating is done on each and every customer attribute, by the customers. The information from the user and non user are achieved through forced choice survey, which requires the customer to identify the importance of each of the requirements. Scale 1 to 5(1=Least, 5= most) Customer Satisfaction Rating: In the same research instruments, a satisfaction rating of different master bathroom and their facility are also mentioned.

Table-2: Customer Importance Rating

S. No.	Customer Requirements	Importance Rating
1	Natural light & ventilation	7
2	A sink	5
3	Water heater	2
4	One toilet	5
5	Bath tub	3
6	Large counter top durable material	6
7	Flooring in the bathroom	4
8	Toilet wall tiles	4
9	Toilet door easy to clean – smooth	5
10	Shower	4

4. Developing Technical Requirements: This is all process of translating the customer requirements into design parameters in a way to force the team to define, using measurable and actionable statements. These are collected through a series of steps which included – structured and unstructured questionnaire and interview with the pertinent personnel which includes real estate agents, engineers, architects, contractors, room property brokers and housing sale representatives. Various manuals, brochures, leaflets, system –chart and websites on master bathroom are of immense helps in the ten attributes are considered for QFD matrix in table-3.

Table-3: Technical Requirements

S.No.	Technical Requirements
1	Increase size of net for natural light and ventilation
2	A sink good quality.
3	Geyser in bathroom
4	One toilet
5	Introduce a bathtub in master bedroom.
6	Marble or granite counter top.
7	Flooring with anti skid tiles
8	Toilet wall tiles with ceramic materials.
9	Toilet door with PVC make
10	Shower with faucet

5. Correlating the Design Parameters: The top of the house referred to as roof of the house is the correlation matrix. It is designed to show the correlation between one design parameter with the others and indicates the synergic impact changes in the technical attributes. The correlation data are defined with symbols for positive or negative relationship.

6. Developing the Correlation Matrix between the Customer Needs and Design Parameters: The central body of the house known as Relationship matrix provides a mechanism for analysis how each design parameter will help achieving each of the customer requirements in table- 4. These are achieved through discussions and deliberations with the concerned technical personnel. The relationship scale used is: \square = 3– Strong, \square = 2 – Average, Δ = 1- Weak Blank – No Relationship.

Technical Requirements	Customer Requirements	Importance rating	Increase size of net for natural light and ventilation	A sink Good quality	Geyser in bath	A good quality toilet	Introduce a bathtub in master bedroom	Marble or Granite counter top	Flooring with anti skid tiles	Toilet wall tiles with ceramic materials.	Toilet door with PVC make	Shower with faucet
		Natural light & ventilation	7	\square								Δ
A Sink	5		\square									
Water heater	2			\square								\square
One toilet	5				\square							
Bath tub	3					\square						\square
Large counter top durable material	6						\square			Δ		
Flooring in the bathroom	4							\square		Δ		
Toilet wall tiles	4					\square				\square		
Toilet door easy to clean – smooth	5										\square	
Shower	4	Δ		\square								\square

7. Developing Target for design parameters: In the table 5, directly below the priorities, a row has been added to address the targets. The targets pertain to the technical attributes mentioned in each column. These targets add the necessary details to bring the service definition from the abstraction of words to the concrete reality of product and process engineer.

Table-5: Target for design parameters

S. No.	Technical Requirements	Targets Value
1	Increase size of net for natural light and ventilation	Steel net size 3X 3 Feet with glass
2	A sink good quality	24 Inch sink ceramic material
3	Geyser in bath	A good quality of geyser
4	A good quality toilet	Area around 3 X 3 Feet and good quality toilet
5	Introduce a bathtub in master bedroom	Small bathtub size max. 5 feet
6	Marble or granite counter top	Marble style colour size 3 feet long
7	Flooring with anti skid tiles	Size 6 X 8 inch
8	Toilet wall tiles with ceramic materials.	Size 8 X 8 inch – model
9	Toilet door with PVC make	Toilet door size 6.5 X 2.5 feet with PVC
10	Shower with faucet	Area around 3 X3 Feet with good quality of shower

8. Customer Assessment: This measures the customer perception of the service relative to the competition. Data collected from customers is used as a basis for comparison show in table-6. Project –A (Surveying Project), Project B, C (Competitor project) Measurement Scale 1 to 5 (1=Least, 5= Most).

Table-6: Customer Assessment

S. No.	Customer requirements	Degree of Importance	Comparison Competitor		
			project –A	Project -B	Project -C
1	Natural light & ventilation	7	3	4	4
2	A sink	5	3	2	2
3	Water heater	2	3	1	1
4	One toilet	5	3	3	3
5	Bath tub	3	2	1	1
6	Large counter top durable material	6	1	1	1
7	Flooring in the bathroom	4	3	3	2
8	Toilet wall tiles	4	4	2	2
9	Toilet door easy to clean – smooth	5	2	2	2
10	Shower	4	3	1	1

9. Technical Assessment: In the table -7, this technical competitor Assessment involves technical details of the product or service. Subjective rating scale of 1 to 5(1=Least, 5= Most) is used to establish engineering specification. Project –A (Surveying Project), Project B, C (Competitor project).

Table-7: Technical assessment

S. No.	Technical requirements	Comparison Competitor		
		project – A	Project – B	Project - C
1	Increase size of net for natural light and ventilation	3	2	2
2	A sink good quality.	5	3	3
3	Geysers in bath	2	2	2
4	One toilet	1	1	1
5	Introduce a bathtub in master bedroom.	3	1	1
6	Marble or granite counter top.	3	1	1
7	Flooring with anti skid tiles	3	2	2
8	Toilet wall tiles with ceramic materials.	2	1	1
9	Toilet door with PVC make	2	2	2
10	Shower with faucet	2	1	1

4. RESULT & DISCUSSION

These row weights can help an organisation evaluate the relative significance of rows. They can assign a team by leading some quantitative value to be use in conjunction with judgement about competitive evaluation, complaints and the other data such as marketing and sale trends, changing societal issue and demographics. In the table-8 various technical descriptions and their corresponding absolute weight and relative weight which obtaining from deployment of voice of customer.

Table-8: Absolute weight and Relative weight

S .No.	Technical Requirements	Absolute Weight	Relative Weight
1	Increase size of net for natural light and ventilation	11.2	40
2	A sink good quality.	8	36.8
3	Geysers in bathroom for hot water	3.2	9.6
4	One toilet	8	24
5	Introduce a bathtub in master bedroom.	7.5	38.9
6	Marble or granite counter top.	30	90
7	Flooring with anti skid tiles	6.4	19.2
8	Toilet wall tiles with ceramic materials.	5	51.4
9	Toilet door with PVC make	12.5	48.7
10	Shower with faucet	6.4	40.6

APPENDIX

Questionnaire on practicality and constraints in QFD implementation:

Customer Requirements Importance Rating

1. Natural light & ventilation in the bathroom:

[1] Most Required [2] Required [3] Desirable [4] Not Desirable [5] Wastage of required []

2. One sinks for wash:

[1] Most Required [2] Required [3] Desirable [4] Not Desirable [5] Wastage of required []

3. Water Heater:

[1] Most Required [2] Required [3] Desirable [4] Not Desirable [5] Wastage of required []

4. One Toilet:

[1] Most Required [2] Required [3] Desirable [4] Not Desirable [5] Wastage of required []

5. One bathtub:

[1] Most Required [2] Required [3] Desirable [4] Not Desirable [5] Wastage of required []

6. Large counter top durable material:

[1] Most Required [2] Required [3] Desirable [4] Not Desirable [5] Wastage of required []

7. Bathroom flooring tiles:

- [1] Most Required [2] Required [3] Desirable [4] Not Desirable [5] Wastage of required []
8. Bathroom wall tiles:
[1] Most Required [2] Required [3] Desirable [4] Not Desirable [5] Wastage of required []
9. Toilet door easy to clean - smooth:
[1] Most Required [2] Required [3] Desirable [4] Not Desirable [5] Wastage of required []
10. Shower:
[1] Most Required [2] Required [3] Desirable [4] Not Desirable [5] Wastage of required []

5. CONCLUSION

Master bathroom unit was design to ensure the user basic needs, aesthetic requirement and expectations of current generation. In this paper an attempt has been made to develop a modular quality function deployment model for master bathroom by help of customer and technical assessment. The aim of modifying the bathroom by QFD application can be obtained in real estate project. Quality Function Deployment is a valuable and flexible tool from design stage and in development and interior of master bathroom.

REFERENCES

- [1] M.N Sudhindra Ku.and Divya Drshan C.S., “Design of a Portable Modular Kitchen Unit”, M.S Ramaiah School of Advanced Studies –Postgraduate Engineering and Management Program (PEMP)
- [2] Luiz Anlonio Gargion, “Using Quality Function Deployment in the design phase of an apartment construction project”, University of California, Berkley, CA,USA, 26-28 July,1996.Low Sui P
- [3] heng , and Lorry Yeap ,“Quality function Deployment in Design /Build projects” Journal of Architectural Engineering ,2001.
- [4] Ronald G. Day, “Quality Function Deployment” Tata McGraw-Hill Publishing Company Ltd, 1996.
- [5] Juran, J.M.,Quality Control Handbook (3rd Ed.). New York, McGraw-Hill, 1974.
- [6] Hong Suk Lee, Kyeong Won Lee, “Practical Case Study of Revolving the physical contradiction in TRIZ: Super Water saving Toilet System Using Flexible Tube”.
- [7] Nikhil Chandra Shil, Abu Rashed Osman, “Quality Function Deployment for Customer Satisfaction in Banking Services”, Daffodil International University Journal of Business and Economics, Vol. 2, No. 2, July 2007
- [8] Mayank Maewall, Patrick Dumes "Quality Function Deployment: Health Care Improvement, 2012.
- [9] J.R. Sharma, Dr. A. R. Rawani, “Quality Function Deployment for service industries from customer requirement to customer satisfaction” Industrial Engineering Journal Vol. XXXV No. 11 pp 14-18, 2006.
- [10]HPD Design Guidelines for New Construction, Revised August 1, 2000.
- [11]Akao, Y. “ An Introduction to Quality Function Deployment” Quality Function Deployment (QFD) : Integrating Customer Requirement into product design. Akao, ed. Productivity Press, Cambridge, Massachusetts, 1 – 24, 1990.
- [12]Yogi Akao Asahi University, “QFD: Past, Present and Future” International Symposium on QFD 1997 – Linkoping, 1997.
- [13]Marvin E, Gonzalez Quesada, and A. Terry Bahill “Improving product Design using Quality Function Deployment: The School Furniture Case in Developing Countries” Quality Engineering Vol. 16 pp 47-58, 2003.
- [14]Anon, “Designing for Customer Satisfaction” Management Decision 32 pp 27- 36, 1994.
- [15]Chia – Hao Chang “Quality Function Deployment (QFD) Processes in an Integrated Quality Information System” Computer industrial. Engg. Vol. 17 nos. 1-4 pp. 311-316, 1989.
- [16]Shamssuddin Ahmed, MujiBul Haque “SCM Design for Water Distribution With QFD Approach “Issues in information Systems Volume VIII No. 2, 2007.
- [17]Low. S.P. “Building on quality: The QFD technique for construction” The surveyor, Kuala Lumpur, Malaysia, 33(4), 4th Quarter, 26-34, 1998.
- [18]Yeap, L. “Application of quality function deployment in design and build contract.” MSc Thesis, Dept. of Build., University of Singapore, Singapore. , 2000.
- [19]Davood Gharakhani, Javad Eslami, “ Determining customer needs priorities for improving service quality using QFD” , International Journal of Economics and Management Sciences Vol. 1, No. 6, pp. 21-28,2012
- [20]Sukhlal Mujalda, Devendra Singh Verma, “Quality Function Deployment for Row House Construction in Real Estate”, International Journal of Scientific and Technology Research Volume 4, Issue 6 pp 182-190, 2015
- [21]<http://www.qfdi.org>
- [22]<http://www.qfdcapture.com>
- [23]<http://ieeexplorer.com>
- [24] www.pinterest.com
- [25] www.hgtv.com

Quality Function Deployment Chart:

S. No. Of Customer Requirements ↓	Imp. Rating ↓	S. No. of Technical Requirements →										Customer Assessment 5=Excellent 4=Very Good 3=Good 2=Average 1=Poor		
		1	2	3	4	5	6	7	8	9	10	Project-A	Project-B	Project-C
1	7	⊕								Δ		3	4	4
2	5		⊕									3	2	2
3	2			⊕		○					○	3	1	1
4	5				⊕							3	3	3
5	3					⊕					○	2	1	1
6	6						⊕		Δ			1	1	1
7	4							⊕	Δ			3	3	2
8	4					○				⊕		4	2	2
9	5										⊕	2	2	2
10	4	Δ	○								⊕	3	1	1
Technical Assessment 5=Excellent 4=Very Good 3=Good 2=Aver. 1=Poor	Our Project-A	3	5	2	1	3	3	3	2	2	2			
	Project-B	2	3	2	1	1	1	2	1	2	1			
	Project-C	2	3	2	1	1	1	2	1	2	1			
Absolute Weight		11.2	8	3.2	8	7.5	30	6.4	5	12.5	6.4			
Relative Weight		40	36.8	96	24	38.9	90	19.2	51.4	48.7	40.6			
⊕=Strong (3 Point) ○=Average (2 Point) Δ=Weak (1 Point)		Project-A (Surveying Project) Project-B (Competitor Project) Project-C (Competitor Project)					⊕ = Value must be attained ↑ = Increase ↓ = Decrease							