

An Application of Quality Function Deployment for Modular Kitchen

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ABSTRACT: In the present scenario, modular kitchens are need of every house-hold and family which are made for well-planned spacious houses, but spaces saving kitchen designs which are efficient for present needs, visual and well ventilated and comfortable are not available. Using the QFD house of quality modal, it was able to understand the fundamental requirements of customers and quality and care and basic requirements within the real estate. This paper represent a simple case using QFD on the design phase of a real estate construction project as a tool for improvement in modular kitchen 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, and to adopt some of the tables and matrix as used in QFD. From the result of modular kitchen by QFD applications to short out the parameters which are needed to modify, according to voice of customer and the results are used for new generalized design.

KEYWORDS: Quality function deployment, Modular kitchen, House of quality, Multifunctional.

I. INTRODUCTION

Modular kitchen, a significant development in the world of kitchen has worked tremendously in bringing down the common problems of a kitchen. It is an intelligent approach towards positioning the key kitchen appliances in a systematic manner to avoid unnecessary wastage of time and effort. Very convincingly it has entered the premises of today's homes to never leave. Modular kitchens are not only aesthetic but also quite practical and handy, especially for the contemporary families. Decorating the modular kitchen will no longer be a difficult and time consuming task. The Concept and the ethics we run by is to deliver a product for the masses. Kitchens 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 or below to middle segment group.

II. BACKGROUND OF QUALITY FUNCTION DEPLOYMENT

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. QFD can be seen as a process where the consumer's voice is valued to carry through the whole process of production and services. QFD was developed by Yoji Akao in japan in 1966. By 1972 the power approach had been well demonstrated the at 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) There are six basic elements of QFD, which are:

1. Determining the customer requirements (The QFD what).
2. Meeting how the requirements can be achieved (The QFD How) of the customers are critical to final product control.
3. Relationship between the requirements and how they are to be met.
4. Target values for the requirements.

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5. Relationships between how the requirements are to be met.
6. A quantification of the importance of the requirements.

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.

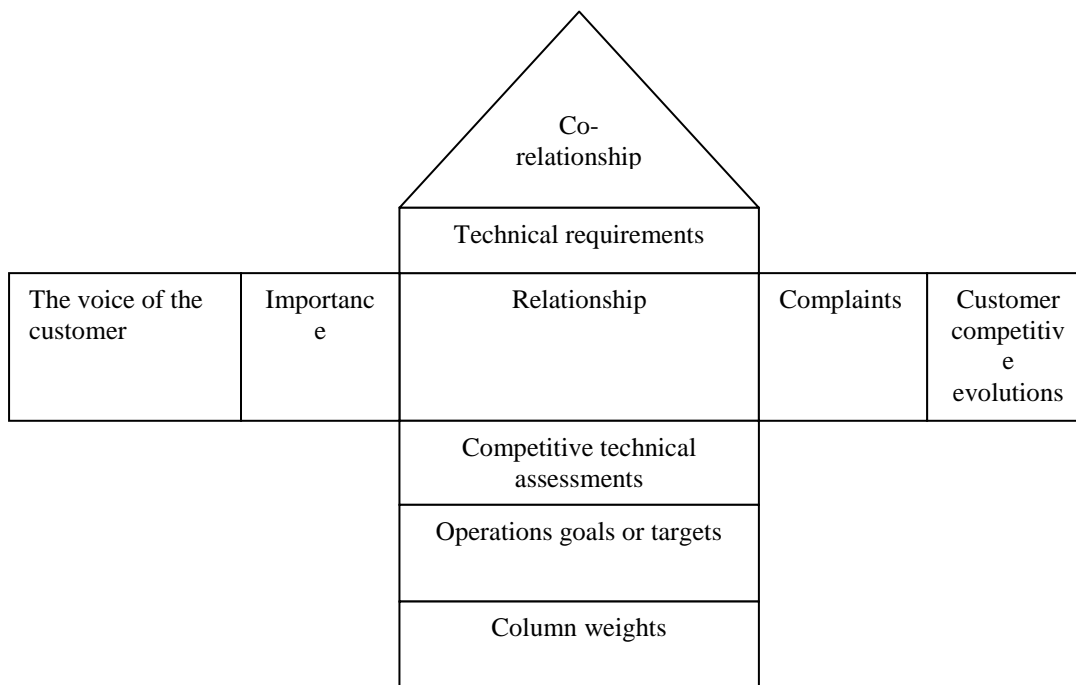


Figure-1: The basic elements of the QFD

CASE STUDY: These case studies apply QFD in the design improvement of modular kitchen located on an urban area of Indore city in India. The construction area was approximate 10' X 8' in L-Shaped layout of kitchen. The estimate budget for this project was around Rs 1.5 Lac.

III. STRATEGY AND METHODOLOGY

The basic Quality Function Deployment methodology involves four basic phases that occur over the course of the product development process show in figure-2. During each phase one or more matrices are prepared to help plan and communicate critical product and process planning and design information. This QFD methodology flow is represented below. Our Phase QFD Approach: Once customer needs are identified, preparation of the product planning matrix or "house of quality" begins.

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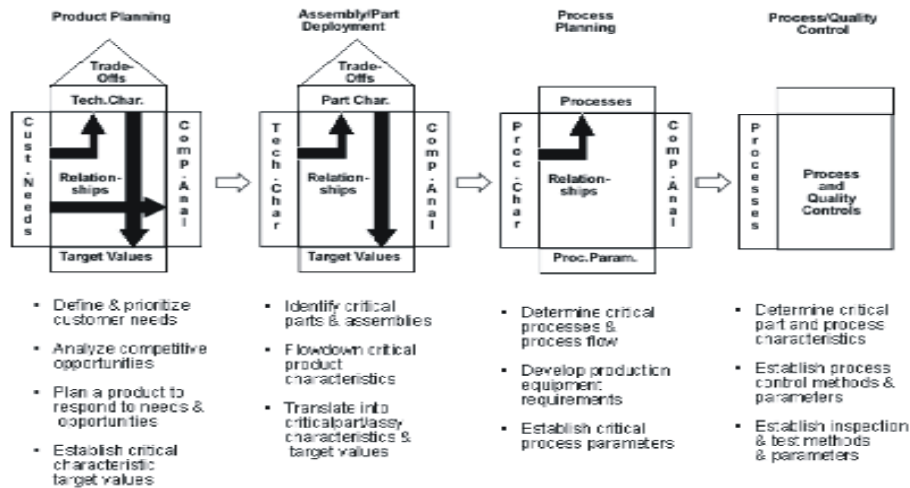


Figure-2: QFD methodology flow

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

- 1. Identification and definition of product:** The concept of QFD is used for modular kitchen. These projects apply QFD in the design and development improvement of modular kitchen. 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 (real estate agent) 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 modular kitchen 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 modular kitchen. Along with this a number of modular kitchens related case study and research paper are also referred. Fourteen parameters are finally considered combining the essence of whole gamut of user’s requirements in the table-1.

S. No.	Customer Requirements
1	One kitchen entrance
2	Large counter top
3	Space for full size appliance
4	One sink for wash
5	Fitted chimney and Hob
6	Kitchen Shelves
7	Kitchen Panels
8	Soft closing Drawers
9	Rolling Shutters
10	Top opening Cabinet

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11	Modular Kitchen Pantry
12	Corner storage system
13	Kitchen door easy to clean – water proof
14	Kitchen tiles easy to clean

Table-1: Customer Requirements

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 modular kitchen and their facility are also mentioned.

S. No.	Customer Requirements	Importance Rating
1	One kitchen entrance	5
2	Large counter top	3
3	Space for full size appliance	4
4	One sink for wash	2
5	Fitted chimney and Hob	5
6	Kitchen Shelves	2
7	Kitchen Panels	3
8	Soft closing Drawers	4
9	Rolling Shutters	3
10	Top opening Cabinet	3
11	Modular Kitchen Pantry	4
12	Corner storage system	4
13	Kitchen door easy to clean – water proof	2
14	Kitchen tiles easy to clean	2

Table-2: Customer Importance Rating

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, property brokers and housing sale representatives. Various manuals, brochures, leaflets, system –chart and websites on modular kitchen are of immense helps in the ten attributes are considered for QFD matrix in table-3.

S .No.	Technical Requirements
1	One kitchen entrance separated from living/dining room
2	MS frame counter top in the kitchen
3	More space in the kitchen for full appliance
4	Sink stainless steel
5	Stainless steel cabinet
6	Shelves that along with being stylish, storage space and variety of racks
7	Flooring build with ceramic tiles
8	Stainless steel pantry , aesthetically designed and heat resistant
9	Aluminium and toughened black glass rolling shutter.
10	Stainless steel panel kitchen chimney

Table-3: Technical Requirements

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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: $\textcircled{\Delta}$ = 3– Strong, $\textcircled{\circ}$ = 2 – Average, Δ = 1- Weak Blank – No Relationship.

Technical Requirements \longrightarrow

Customer Requirements	Importance rating	One kitchen entrance separated from living/dining room	MS frame counter top in the kitchen	More space in the kitchen for full appliance	Sink stainless steel	Stainless steel cabinet	Shelves that along with being stylish, storage space and variety of racks	Flooring build with ceramic tiles	Stainless steel pantry , aesthetically designed and heat resistant	Aluminium and toughened black glass rolling shutter.	Stainless steel panel kitchen chimney
One kitchen entrance	5	$\textcircled{\Delta}$									
Large counter top	3		$\textcircled{\Delta}$			$\textcircled{\circ}$					
Space for full size appliance	4	Δ	Δ	$\textcircled{\Delta}$							
One sink for wash	2				$\textcircled{\Delta}$						
Fitted chimney and Hob	5					Δ		$\textcircled{\Delta}$			
Kitchen Shelves	2						$\textcircled{\Delta}$				
Kitchen Panels	3						$\textcircled{\circ}$				
Soft closing Drawers	4						$\textcircled{\circ}$		$\textcircled{\circ}$		
Rolling Shutters	3						$\textcircled{\circ}$				
Top opening Cabinet	3						$\textcircled{\circ}$		$\textcircled{\circ}$	$\textcircled{\Delta}$	
Modular Kitchen Pantry	4							$\textcircled{\Delta}$			
Corner storage system	4			$\textcircled{\circ}$			$\textcircled{\Delta}$				
Kitchen door easy to clean – water proof	2	$\textcircled{\circ}$									
Kitchen tiles easy to clean	2										$\textcircled{\Delta}$

Table-4: Relationship between What and How

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- 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.

S. No.	Technical Requirements	Targets Value
1	One kitchen entrance separated from living/dining room	Door size 7 X 3 Feet
2	MS frame counter top in the kitchen	A good quality of counter top in MS frame
3	More space in the kitchen for full appliance	Increase 10% Sq. Feet
4	Sink stainless steel	24 Inch Sink stainless steel
5	Stainless steel cabinet	soft closing drawer cabinet with fittings from Hettich
6	Shelves that along with being stylish, storage space and variety of racks	A good quality of Wood, ply, MDF, acrylic boards.
7	Flooring build with ceramic tiles	Size 2 X 2 Feet – Model
8	Stainless steel pantry , aesthetically designed and heat resistant	A good quality of stainless steel material
9	Aluminium and toughened black glass rolling shutter.	Glass door with translucent materials
10	Stainless steel panel kitchen chimney	A good quality of Hub and Chimney

Table-5: Target for design parameters

- 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).

S. No.	Customer requirements	Degree of Importance	Comparison Competitor		
			project -A	Project -B	Project -C
1	One kitchen entrance	5	3	4	3
2	Large counter top	3	4	2	3
3	Space for full size appliance	4	5	2	3
4	One sink for wash	2	1	1	1
5	Fitted chimney and Hob	5	5	2	2
6	Kitchen Shelves	2	3	2	4
7	Kitchen Panels	3	3	2	2
8	Soft closing Drawers	4	3	3	3
9	Rolling Shutters	3	4	3	2
10	Top opening Cabinet	3	3	1	1
11	Modular Kitchen Pantry	4	4	3	4
12	Corner storage system	4	3	2	1
13	Kitchen door easy to clean– water proof	2	3	2	2
14	Kitchen tiles easy to clean	2	1	1	1

Table-6: Customer Assessment

- 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)

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S. No.	Technical requirements	Comparison Competitor		
		project -A	Project -B	Project - C
1	One kitchen entrance separated from living/dining room	4	3	3
2	MS frame counter top in the kitchen	4	3	2
3	More space in the kitchen for full appliance	5	3	4
4	Sink stainless steel	3	3	3
5	Stainless steel cabinet	3	2	2
6	Shelves that along with being stylish, storage space and variety of racks	3	2	2
7	Stainless steel panel kitchen chimney	3	2	2
8	Stainless steel pantry , aesthetically designed and heat resistant	3	2	3
9	Aluminium and toughened black glass rolling shutter.	4	2	2
10	Flooring build with ceramic tiles	2	1	1

Table-7: Technical assessment

IV. 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.

S .No.	Technical Requirements	Absolute Weight	Relative Weight
1	One kitchen entrance separated from living/dining room	23	48
2	MS frame counter top in the kitchen	13	15.25
3	More space in the kitchen for full appliance	20	24.8
4	Sink stainless steel	6	30
5	Stainless steel cabinet	11	17.5
6	Shelves that along with being stylish, storage space and variety of racks	32	39.5
7	Flooring build with ceramic tiles	15	20
8	Stainless steel pantry , aesthetically designed and heat resistant	26	37.4
9	Aluminium and toughened black glass rolling shutter.	9	48
10	Stainless steel panel kitchen chimney	6	30

Table-8: Absolute weight and Relative weight

V. CONCLUSION

Modular kitchen unit was done to ensure whether the product output fulfils the user needs, requirement and expectation. In this paper an attempt has been made to develop a modular quality function deployment model. The aim was to

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modify the QFD application and apply it in real estate project. Quality Function Deployment is a valuable and very flexible tool for design and development of modular kitchen.

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.
3. Low Sui Pheng , 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. Mayank Maewall, Patrick Dumes "Quality Function Deployment: Health Care Improvement, 2012.
8. 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.
9. HPD Design Guidelines for New Construction, Revised August 1, 2000.
10. 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.
11. Yogi Akao Asahi University, "QFD: Past, Present and Future" International Symposium on QFD 1997 – Linkoping, 1997.
12. 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.
13. Anon, "Designing for Customer Satisfaction" Management Decision 32 pp 27- 36, 1994.
14. 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.
15. Shamsuddin Ahmed, MujiBul Haque "SCM Design for Water Distribution With QFD Approach "Issues in information Systems Volume VIII No. 2, 2007.
16. Low. S.P. "Building on quality: The QFD technique for construction" The surveyor, Kuala Lumpur, Malaysia, 33(4), 4th Quarter, 26-34, 1998.
17. Yeap, L. "Application of quality function deployment in design and build contract." MSc Thesis, Dept. of Build., University of Singapore, Singapore. , 2000.
18. <http://www.qfdi.org>
19. <http://www.qfddcapture.com>
20. <http://ieeexplorer.com>

APPENDIX

Questionnaire on practicality and constraints in QFD implementation:

Customer Requirements	Importance Rating
1. One kitchen entrance: [1] Excellent [2] Very Good [3] Good [4] Average [5] Poor	[]
2. Large counter top: [1] Excellent [2] Very Good [3] Good [4] Average [5] Poor	[]
3. Space for full size appliance: [1] Excellent [2] Very Good [3] Good [4] Average [5] Poor	[]
4. One sinks for wash: [1] Excellent [2] Very Good [3] Good [4] Average [5] Poor	[]
5. Fitted chimney and Hob: [1] Excellent [2] Very Good [3] Good [4] Average [5] Poor	[]
6. Kitchen Shelves: [1] Excellent [2] Very Good [3] Good [4] Average [5] Poor	[]
7. Kitchen Panels: [1] Excellent [2] Very Good [3] Good [4] Average [5] Poor	[]
8. Soft closing Drawers: [1] Excellent [2] Very Good [3] Good [4] Average [5] Poor	[]
9. Rolling Shutters: [1] Excellent [2] Very Good [3] Good [4] Average [5] Poor	[]

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10. Top opening Cabinet: []
11. Modular Kitchen Pantry: []
12. Corner storage system: []
13. Kitchen door easy to clean – water proof: []
14. Kitchen tiles easy to clean: []

Quality Function Deployment Chart: House of Quality:

Direction of Improvement		⊕	↑	⊕	↑	↑	⊕	↑	↑	⊕						
S. No. Of Customer Requirements	Imp. Rating	S. No. of Technical Requirements										Customer Assessment				
		1	2	3	4	5	6	7	8	9	10	Project -A	Project -B	Project -C		
1	5	⊕												3	4	3
2	3		⊕			○								4	2	3
3	4	Δ	Δ	⊕										5	2	3
4	2				⊕									1	1	1
5	5					Δ		⊕						5	2	2
6	2						⊕							3	2	4
7	3						○							3	2	2
8	4						○		○					3	3	3
9	3						○							4	3	2
10	3						○		○	⊕				3	1	1
11	4								⊕					4	3	4
12	4			○				⊕						3	2	1
13	2	○												3	2	2
14	2										⊕			1	1	1
Technical Assessment 5=Excellent 4=Very Good 3=Good 2=Aver. 1=Poor	Our Project -A	4	4	5	3	3	3	2	3	4	3					
	Project-B	3	3	3	3	2	2	1	2	2	2					
	Project-C	3	2	4	3	2	2	1	3	2	2					
Absolute Weight		23	13	20	6	11	32	1	26	9	6					
Relative Weight		48	15.2	24	3	17	39	2	37	4	3					
		5	.8	0	.5	.5	.5	0	.4	.8	0					
⊕=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									