

Quality Function Deployment For Row House Construction In Real Estate

Sukhlal Mujalda, Devendra Singh Verma

Abstract: House construction for real state is the current demand to satisfy the different categories of customer. Various techniques are available to satisfy the customer demand like QFD. Using the QFD house of quality modal, we were able to understand the fundamental customer quality and care requirement within the real estate construction. This paper represent a simple case using QFD on the design phase of a real estate construction project as a tool of improvement for feature of middle class row house unit.

Key words: Quality function deployment, row house, building construction, House of quality, customer satisfaction.

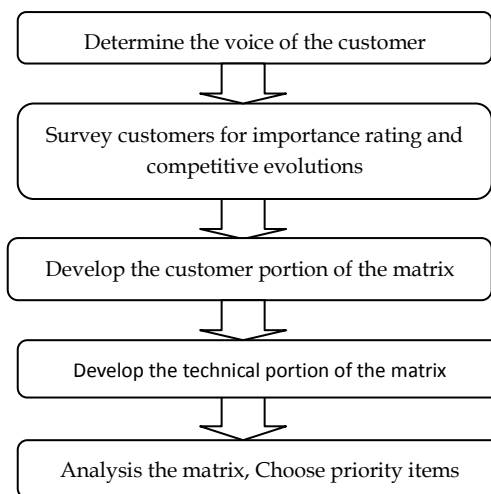
Introduction:

India is a country with a big heart and dream. It is a great place to dream about something big for pleasure and comfort. The dreams come true very quickly here because of good quality products like row house. Everyone can find a place to live that would fit his own expectations and budget. Now, Villas and flats available in the resorts are usually more expensive than in the rest of the house and property. Moreover, if one chooses row house in some ancient building, should be ready to pay more due to its historical and market value. The number of new buildings in each city is now growing month per month and there are a lot of chances to get a perfect independent house with modern design. Construction companies that operate in India Real Estate housing market are trying to improve the design and development phase in their projects so that they can better satisfy the needs of customer and users, especially for row housing building. Many companies dedicated only for multiple family constructions agree that the most important aspect in the real estate market is the value that they can provide to their customers. In the new era customer's choice in row houses construction building directed towards individual building and all features requirement to fulfill the demand of single row house unit.

Importance 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 invented in Japan by Yoji Akao in 1966, but was first implemented in the Mitsubishi's Kobe shipyard in 1972, possibly out of the teaching of Deming. Then later it was adopted and developed by other Japanese companies, notably Toyota and its suppliers.

Flow Chart of QFD Process:



Case Study:

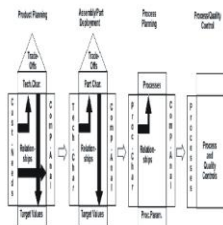
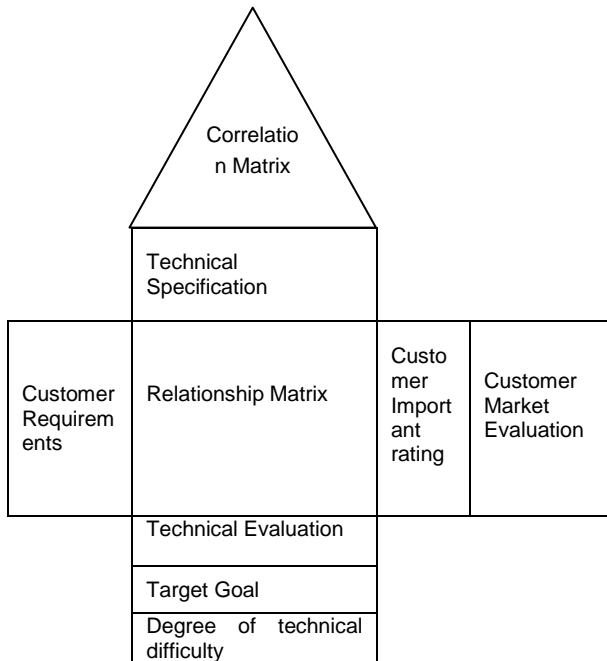
These case studies apply QFD in the design improvement of a row house building located on an urban area of Indore city in India. The construction area was approximate 1000 square feet. The estimate budget for this project was around Rs 3500000.00 the basic layout of each unit includes 2 bedroom, 1 master bedroom, 3 bathrooms, 1 living room, kitchen, laundry and balcony. The developer of this project is a small owner operated real estate development and construction company.

QFD: Methodology & Application for Row House Construction:

The intent of the study is to introduce and elaborate the procedure of a QFD based Real Estate construction improvement process. The following steps discuss the methodology and its implementation as applied to a certain real estate construction, elucidating the important issues and aspects in building up house of quality. Figure 1 shows the basic building blocks of the house of quality- QFD

Sukhlal Mujalda, Assistant workshop superintended,
S.G.S.I.T.S. Indore M.P. India,
E-mail: sukhmjaan@yahoo.com
Devendra Singh Verma, Prof. Department of Mechanical
Engineering, IET, DAVV Indore M.P. India,
E-mail: dev1_ver@yahoo.co.in

Diagram -2: House of Quality



- Define/Analyze customer needs
- Analyze competitor capabilities
- Plan a product against needs & capabilities
- Establish critical parameters/ target values
- Identify critical parts/assemblies
- Plan/Identify critical processes
- Translate the requirements into critical parameters/ target values
- Determine critical processes & processes flow
- Develop production equipment requirements
- Establish critical process parameters
- Determine critical part/process/ manufacturing
- Establish process control methods & parameters
- Establish inspection & control methods & parameters

1. Identification and definition of product:

The concept of QFD is used for Row House Construction. These projects apply QFD in the design improvement and quality features of Row Houses. It is decided to take into account three of the leading builder’s row house construction Pvt. Ltd as per their current market. These three competitors are code named as A, B and C for practical convenience. QFD is used as a tool in this project to priorities important points that could offer a potential of improvement according to the client requirements and needs. Data collection through questionnaire based interview and literature study formed the basis of the whole exercise. For this project two techniques are used for gathering information on customer needs and desire for the row house construction. 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

row houses composed the focus groups. Around 50 persons are taken as sampling units.

2. Determine the customer requirements:

For the purpose of gathering data, row 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 row house construction. Along with this a number of row house construction related case study and research paper are also referred. Thirty four parameters are finally considered combining the essence of whole gamut of user’s requirements.

1. Social entrance-other for kitchen
2. One kitchen entrance
3. Large counter top –durable material.
4. Space for full size appliance.
5. One sink for wash
6. Extra space for TV
7. Space for full size dining table.
8. Natural light and ventilation
9. Dressing Room
10. One bathroom
11. Natural light and ventilation
12. Dressing Room
13. Natural light and ventilation.
14. Large counter top durable material
15. One bath tub with shower head
16. Water heater for faucet in the sink
17. One Toilet
18. Natural light and ventilation.
19. Large counter top durable material
20. Water heater for faucet in the sink
21. One toilet
22. One balcony with connection with master bedroom
23. Social entrance with wood door décor
24. Kitchen door easy to clean – water proof
25. Internal to door easy clean –smooth
26. Toilet door easy to clean –smooth
27. Sliding plain aluminum windows
28. Cable TV & telephone point at all rooms
29. Emergency lighting in common areas
30. AC pipe in each room
31. Space for full size car parking
32. Space for full size appliance
33. Bathroom, Kitchen, Bedroom tiles easy to clean
34. Anti skid tiles in bathroom

3. Determine of Priority rating:

Customer Importance Rating: 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 9 (1=Least,9= Most) Customer Satisfaction Rating: In the same research instruments, a satisfaction rating of different row house construction and their facility are also mentioned. This data assessed the respondent’s satisfaction level against all the thirty four users’ requirements. Scale 1 to 9

Table-1: Customer Important Rating

S. No.	Customer Requirements	Important Rating
1	1.Social entrance-other for kitchen	8
2	2.One kitchen entrance	8
3	1. Large counter top –durable material.	3
4	2. Space for full size appliance.	9
5	3.One sink for wash	5
6	1.Extra space for TV	6
7	2. Space for full size dining table.	9
8	1.Natural light and ventilation	7
9	2.Dressing Room	5
10	3.One bathroom	7
11	1.Natural light and ventilation	8
12	2.Dressing Room	5
13	1. Natural light and ventilation.	7
14	2.Large counter top durable material	6
15	3.One bath tub with shower head	3
16	4.Water heater for faucet in the sink	6
17	5. One Toilet	5
18	1. Natural light and ventilation.	8
19	2.Large counter top durable material	1
20	3.Water heater for faucet in the sink	2
21	4. One toilet	5
22	1.One balcony with connection with master bedroom	9
23	1.Social entrance with wood door décor	8
24	2.Kitchen door easy to clean – water proof	6
25	3.Internal to door easy clean –smooth	6
26	4.Toilet door easy to clean –smooth	5
27	1.Sliding plain aluminum windows	6
28	1.Cable TV & telephone point at all rooms	9
29	2. Emergency lighting in common areas	6
30	3.AC pipe in each room	3
31	1.Space for full size car parking	6
32	1.Space for full size appliance	4
33	1.Bathroom, Kitchen, Bedroom tiles easy to clean	6
34	2.Anti skid tiles in bathroom	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, property brokers and row housing sale representatives. Various manuals, brochures, leaflets, system –chart and websites on row house construction are of immense helps in the twenty nine attributes are considered for QFD matrix.

Technical Requirements:-

1. One social entrance separated from the kitchen entrance
2. One kitchen entrance separated from living/dining room
3. Large marble or granite counter top in the kitchen
4. More space in the kitchen for full appliance
5. Pre fitted design kitchen cabinet with chimney and hub
6. sink stainless steel
7. Add a multiple space for TV and Stereo
8. Increase the space of living/dining room for full size dining table

9. Increase the size of windows of natural light and ventilation
10. Introduce a bathroom in the bedroom
11. More space in the bedroom for full size appliance
12. More space in the dressing room for full size appliance
13. Increase the size of windows of natural light and ventilation
14. Introduce a bathtub in master bedroom's bathroom
15. Geyser in bathroom
16. Ono Toilet
17. Marble or granite counter top in bathroom
18. Reduce the no. of balcony in the unit only one connected with master bedroom
19. Increase space of porch and car parking for full size appliance
20. Geyser in bathroom
21. Door made in natural wood material with a wide size
22. Kitchen flush door with laminated finish both side
23. Toilet door with PVC make
24. Powder coated aluminum sliding window
25. TV plug/AC point in all rooms
26. Flooring build with ceramic tiles
27. Bathroom flooring with anti skid ceramic tiles
28. Wall with ceramic tiles
29. Emergency light with batteries and stand by system

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. These are achieved through discussions and deliberations with the concerned technical personnel. The relationship scale used is: 3– Strong, 2 – Average, 1- Weak Blank – No Relationship.

Table-2: Correlation Matrix between the Customer Needs and Design Parameter

Customer Requirement ↓	Imp. Rating ↓	Technical Requirements →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
1	8		⊙	○						△			△											○								
2	8		○	⊙						△			△											○								
3	3				⊙			○	△																						○	
4	9		△	△	△	⊙	○	△	△																				○		○	
5	5								⊙																						△	
6	6									⊙																		○				
7	9		△	△				△		⊙								△											△		○	
8	7						△			△			△		○			○						△	△		○					
9	5												△	⊙																		
10	7													△		△	△	○					○			△						
11	8		○	○			△			△		○			⊙								△	△	△	△					△	
12	5											⊙		△			○	○					○		△			△	△	○		
13	7												△					△	⊙													
14	6												△				⊙	△						△							△	
15	3												○				⊙							⊙								
16	6											○			△	△	⊙	△					△			△		△	△			
17	5		○	○			△			△		△	○		○									△	△		△					
18	8											○						△	⊙												△	
19	1											○					⊙	△														
20	2											○				○	△						△			△			○	○		
21	5																			⊙				⊙				○				
22	9		○	○																			△		△	△						
23	8					△	△																	△	⊙							
24	6											△				△								△	△	⊙						
25	6		△	△							⊙		△		○								△				⊙					
26	5									○			○																			
27	6		△	△						△				○										△							⊙	
28	9													○																		
29	6																											○	○			
30	5																															
31	5																							⊙								
32	4										○	○												△	○			○	○			
33	6				△	△				△																		⊙	○			
34	4																		△	○	△								⊙			

7. Developing Target for design parameters:

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-3: Target for design parameters

S. No.	Technical Requirements	Target Value
1	One social entrance separated from the kitchen entrance	Door with 7 X 3 feet
2	One kitchen entrance separated from living/dining room	Door with 7 X 3 feet
3	Large marble or granite counter top in the kitchen	Marble style/colour size at list 7 feet
4	More space in the kitchen for full appliance	Increase 10% sq. feet
5	Pre fitted design kitchen cabinet with chimney and hub	A good quality of cabinet & chimney
6	sink stainless steel	24 inch sink stainless steel
7	Add a multiple space for TV and Stereo	Increase at least 10% in area of living room
8	Increase the space of living/dining room for full size dining table	Area around 120 sq. Feet
9	Increase the size of windows of natural light and ventilation	Increase at least 10% in area of standard windows
10	Introduce a bathroom in the bedroom	Bathroom size 6 x5 feet
11	More space in the bedroom for full size appliance	Area around 120 sq. Feet
12	More space in the dressing room for full size appliance	Area around 60 sq. Feet
13	Increase the size of windows of natural light and ventilation	Increase at least 10% in area of standard windows
14	Introduce a bathtub in master bedroom's bathroom	Small bathtub max 5 feet
15	Geyser in bathroom	Faucet with water heater
16	Ono Toilet	Area around 40 sq. Feet
17	Marble or granite counter top in bathroom	Marble style colour size 3 feet long
18	Reduce the no. of balcony in the unit only one connected with master bedroom	Only one connected with master bedroom
19	Increase space of porch and car parking for full size appliance	Area around 128 sq. Feet
20	Geyser in bathroom	At least 5 plug
21	Door made in natural wood material with a wide size	Flush door size 7 x 3 feet thick 32 mm
22	Kitchen flush door with laminated finish both side	Flush door size 7 x 3 feet with laminated finish from both side
23	Toilet door with PVC make	Toilet door size 6 x 2.5 feet with PVC make
24	Powder coated aluminum sliding window	Square bar mould window shall have two coated of synthetic enamel paint with 3 mm glass
25	TV plug/AC point in all rooms	At least 5 plug
26	Flooring build with ceramic tiles	Size 2 x2 feet –model
27	Bathroom flooring with anti skid ceramic tiles	Size 6 x 8 inch anti skid tiles
28	Wall with ceramic tiles	Size 8 x8 inch –model
29	Emergency light with batteries and stand by system	A good quality Install system

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. Project –A (Surveying Project= *), Project B, C (Competitor project= Θ , Δ)

Table-4: Customer Assessment

S. No.	Customer requirements	Degree of Importance	Comparison Competitor		
			project A	Project B	Project C
1	1.Social entrance-other for kitchen	8	3	4	3
2	2.One kitchen entrance	8	4	2	3
3	1. Large counter top –durable material.	3	1	1	1
4	2. Space for full size appliance.	9	5	4	4
5	3.One sink for wash	5	3	2	2
6	1.Extra space for TV	6	1	2	4
7	2. Space for full size dining table.	9	5	4	4
8	1.Natural light and ventilation	7	3	4	4
9	2.Dressing Room	5	4	3	2
10	3.One bathroom	7	3	1	1
11	1.Natural light and ventilation	8	4	3	4
12	2.Dressing Room	5	3	2	1
13	1. Natural light and ventilation.	7	3	2	2
14	2.Large counter top durable material	6	1	1	1
15	3.One bath tub with shower head	3	2	1	1
16	4.Water heater for faucet in the sink	6	3	1	1
17	5. One Toilet	5	3	3	3
18	1. Natural light and ventilation.	8	4	3	2
19	2.Large counter top durable material	1	3	1	1
20	3.Water heater for faucet in the sink	2	3	1	1
21	4. One toilet	5	2	1	1
22	1.One balcony with connection with master bedroom	9	5	5	5
23	1.Social entrance with wood door décor	8	4	3	4

24	2.Kitchen door easy to clean – water proof	6	4	2	2
25	3.Internal to door easy clean –smooth	6	2	2	2
26	4.Toilet door easy to clean –smooth	5	2	2	2
27	1.Sliding plain aluminum windows	6	3	2	2
28	1.Calbe TV & telephone point at all rooms	9	5	1	1
29	2. Emergency lighting in common areas	6	1	1	1
30	3.AC pipe in each room	3	5	2	2
31	1.Space for full size car parking	6	5	5	5
32	1.Space for full size appliance	4	4	2	2
33	1.Bathroom, Kitchen, Bedroom tiles easy to clean	6	3	3	2
34	2.Anti skid tiles in bathroom	4	4	2	2

9. Technical Assessment:

This technical competitor Assessment involves technical details of the product or service. Subjective rating scale of 1 to 5 is used to establish engineering specification. Project –A (Surveying Project= *), Project B, C (Competitor project= Θ, Δ)

Table-5: Technical Assessment

Technical Requirement →

Technical Require	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
5				*																									
4			Θ	Δ							*																		
3	Θ		Θ	Θ	Θ	Θ	Θ	*						*			*				*	Θ					*		
2								Θ		Θ	Θ	Θ		Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ
1																													
0		Θ	Δ				Θ	Δ	Θ	Δ		Θ	Δ	Θ	Δ	Θ	Δ	Θ	Δ	Θ	Δ	Θ	Δ	Θ	Δ	Θ	Δ	Θ	Δ
Project –A	4	0	5	5	5	3	0	3	0	2	4	4	0	3	2	0	3	0	3	3	3	2	2	0	0	3	3	2	0
Project –B	3	0	4	3	3	3	0	2	0	2	3	2	0	1	2	0	1	0	2	2	3	2	2	0	0	2	2	1	0
Project –C	3	0	4	4	3	3	0	2	0	2	3	1	0	1	2	0	1	0	2	1	2	1	2	0	0	2	1	1	0

Result:-Obtaining the final results of the importance weight and relative weight of the technical requirements, it was the possible for the design team to prioritize and implement the new layout and new features in the specification and design of the row house unit. In the new design, it was necessary to increase or decrease some of the area or shapes of row house and to eliminate or add new specific solution

Table- 6: Technical requirements and level of importance

S. No.	Technical Requirements	Relative Weight
1	One social entrance separated from the kitchen entrance	148.4
2	One kitchen entrance separated from living/dining room	164.4
3	Large marble or granite counter top in the kitchen	63.6
4	More space in the kitchen for full appliance	36.6
5	Pre fitted design kitchen cabinet with chimney and hub	67.2
6	sink stainless steel	78
7	Add a multiple space for TV and Stereo	99
8	Increase the space of living/dining room for full size dining table	61
9	Increase the size of windows of natural light and ventilation	55
10	Introduce a bathroom in the bedroom	181.3
11	More space in the bedroom for full size appliance	221.85
12	More space in the dressing room for full size appliance	39.95
13	Increase the size of windows of natural light and ventilation	102
14	Introduce a bathtub in master bedroom's bathroom	144.7
15	Geyser in bathroom	71.3
16	Ono Toilet	151.8
17	Marble or granite counter top in bathroom	76.4
18	Reduce the no. of balcony in the unit only one connected with master bedroom	96.5
19	Increase space of porch and car parking for full size appliance	42.4
20	Geyser in bathroom	103.7
21	Door made in natural wood material with a wide size	138.8
22	Kitchen flush door with laminated finish both side	56.9
23	Toilet door with PVC make	51.3
24	Powder coated aluminum sliding window	85.4
25	TV plug/AC point in all rooms	60
26	Flooring build with ceramic tiles	108.4
27	Bathroom flooring with anti skid ceramic tiles	63.8
28	Wall with ceramic tiles	111.2
29	Emergency light with batteries and stand by system	164.8

Conclusions:-

In this paper an attempt has been made to develop a construction row house quality function deployment model. The aim was to modify the QFD application and apply it in real estate construction project. Quality Function Deployment is a valuable and very flexible tool for design and construction of row house. The correlation matrix is the heart of the QFD process and store precision information needed for design improvement.

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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	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	project -A	Project -B	Project -C	
1	8																														3	4	3	
2	8	○	⊕						Δ		Δ																			4	2	3		
3	3			⊕		○	Δ																							1	1	1		
4	9	Δ	Δ	Δ	⊕	○	Δ	Δ																						5	4	4		
5	5					⊕																								3	2	2		
6	6							⊕																						1	2	4		
7	9	Δ	Δ			Δ		⊕											Δ											5	4	4		
8	7				Δ			Δ		Δ		○							Δ	Δ		○								3	4	4		
9	5									Δ	⊕																			4	3	2		
10	7										Δ		Δ	Δ	○						○				Δ					3	1	1		
11	8	○	○		Δ			Δ		○			⊕												Δ	Δ	Δ			Δ	4	3	4	
12	5									⊕		Δ			○	○									○		Δ	Δ	○		3	2	1	
13	7										Δ				Δ	⊕															3	2	2	
14	6									Δ			⊕		Δ										Δ				Δ		1	1	1	
15	3									○				⊕										⊕							2	1	1	
16	6									○				Δ	Δ	⊕	Δ							Δ			Δ	Δ			3	1	1	
17	5	○	○		Δ			Δ		Δ	○		○												Δ	Δ		Δ			3	3	3	
18	8									○																Δ	Δ				4	3	2	
19	1									○				⊕	Δ																3	1	1	
20	2									○				○	Δ										Δ				○	○		3	1	1
21	5																														2	1	1	
22	9	○	○																												5	5	5	
23	8				Δ	Δ																									4	3	4	
24	6									Δ				Δ													Δ	Δ	⊕		4	2	2	
25	6	Δ	Δ							⊕	Δ		○												Δ			⊕			2	2	2	
26	5							○			○																				2	2	2	
27	6	Δ	Δ				Δ				○														Δ					⊕	3	2	2	
28	9										○																				5	1	1	
29	6																															1	1	1

