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Quality Function Deployment Applied On Pvc Plumbing And Cast Iron Plumbing

Avadhesh Singh Gurjar[1], Dr. M.K Trivedi[2]
[1](Research Scholar, Department of civil engineering, MITS Gwalior (m.p.), India 474005)
[2](Professor, Department of civil engineering, MITS Gwalior (m.p.), India 474005)

Abstract: *QFD is a methodology , which establishes a relationship between product descriptor & customer expectation. It is also determine products sale ability and carryout it to a high liable during the process. In this study, QFD methodology was implement in the plumbing services such as PVC plumbing and cast iron plumbing. This study is an effort to try to develop the awareness & importance of plumbing services and its utilization in productive manner among the people. The aim of this study is to use the better plumbing services as per customer requirement, we observed some functional problem. In the first step which is developed by customer voice the relationship which is customer requirement and technical description is determine by QFD and finally calculation all item are evaluated.*

Key words*: building house of quality, Cast iron plumbing, PVC plumbing, QFD methodology.*

I. Introduction

Implementation of the total quality management system at the Mitsubishi Shipyard in Kobe, Japan. In the late 1970s, Toyota further developed the QFD concept to a detailed process that has been used in many manufacturing industries. Sullivan 1986 Reported that Toyota auto body started using QFD in 1977. As a result, Toyota auto body introduced four new van-type vehicles between 1977 and 1984, which is a record time for such an accomplishment. Using 1977 as a base, Toyota reported a 20% reduction in start-up costs on the launch of its new van in 1979, a 38% reduction in 1982, and a cumulative 61% reduction in 1984. During this period, the product development cycle & time to market! was reduced by one-third, and quality was improved because of the significant reduction in the number of engineering changes and retread incidents. QFD is a customer-driven design process. Its use is essential in product design . Sullivan defines QFD as an overall concept that provides a means of translating customer requirements into the appropriate technical requirements . Various applications within the literature can be grouped under three categories as: QFD implementations before the design stage; QFD implementations during the design stage and QFD implementations after the design stage .QFD was originally proposed, through collecting and analyzing the voice of the customer, for QFD's potential fields of applications. QFD is a useful tool for developing the requirements of new products, and its benefits are well documented .

Benefits of QFD

Customer Driven, Provides Documentation, Reduced Implementation time, Promotes Teamwork.

II. Aim Of This Study Are As Follows

1. To meet the need of customer requirement.
2. To make the plumbing services more effective.

III. Pvc Pipes & Castiron Pipes

Polyvinyl-Chloride (PVC) is a plastic product .PVC pipes are light in weight, rates for use under pressure, easy to install, low frictional loss, low on maintenance cost, and have low frictional loss. PVC pipes of different diameters have gained wider acceptance for water supply. Their light weight, low cost, easy installation, non corrosiveness, high tensile strength to withstand high fluid pressure make them ideal for number of purposes. cast iron mains in this country which continue to give satisfactory services even after a century of use. Due to its strength and corrosion resistance , C.I pipes can be used in soils and for water of slightly aggressive character. They are well suited for pressure mains and laterals where tapping are made for house connections. It is preferable to have coating inside and outside of the pipe.Cheap Labor & Cast Iron Years ago, residential construction labor costs were insignificant. Time was not always an issue with respect to how long a particular task took to complete.

Types Of* Customer *Information

1. Solicited, Measurable, Routine :-Customer & Market Surveys, Trade Trials
2. Unsolicited, Measurable, Routine :customer ailment, cause
3. Solicited, Subjective, Routine :-Focus Groups

4. Solicited, Subjective, Haphazard :-confabs, independent, looks up
5. Unsolicited, Subjective, Haphazard :-pattern sellers, provider

IV. Case Study

Here we have taken two different plumbing and study is done at Surya industry Malanpur Gwalior and Sumer Galaxy multistory building Gwalior and according to the detail of market survey that we can use the QFD methodology for obtaining the better plumbing out of two (Cast iron and PVC plumbing).QFD focus on customer expectation or requirement, with the voice of the customer which employed to translate customer expectation in terms of specific requirement and action in terms of technical characteristics.

		TECHNICAL DISCRIPTION/ DESGIN REQUJREMENT (HOW'S)						
		DR1	DR2	DR3	DR4	DR5	DR6	DR7
CUSTOMER REQUIREMENT (WHAT'S)	CR1	R_{11}	R_{12}	R_{13}	R_{14}	R_{15}	R_{16}	R_{17}
	CR2	R_{21}	R_{22}	R_{23}	R_{24}	R_{25}	R_{26}	R_{27}
	CR3	R_{31}	R_{32}	R_{33}	R_{34}	R_{35}	R_{36}	R_{37}
	CR4	R_{41}	R_{42}	R_{43}	R_{44}	R_{45}	R_{46}	R_{47}
	CR5	R_{51}	R_{52}	R_{53}	R_{54}	R_{55}	R_{56}	R_{57}
	CR6	R_{61}	R_{62}	R_{63}	R_{64}	R_{65}	R_{66}	R_{67}
	CR7	R_{71}	R_{72}	R_{73}	R_{74}	R_{75}	R_{76}	R_{77}

Where the relation value is R_{11} = CR1 & DR1, R_{21} = CR2 & DR1
R_{12} = CR1 & DR2, R_{22} = CR2 & DR2
Similar R_{76} = CR7 & DR6, R_{77} = CR7& DR7

V. Prioritized Customer Requirements

Customer rankings will determine the base for the requirements to be prioritized. Table 2 shows the prioritized customer requirements.

1. Importance to Customer-

It will be useful for prioritizing efforts and trade-off decisions where team may have different priorities which are as :

5.1 Focus Team Information (ranks relative importance to customer) Rank each customers requirement by assigning it a value- 10 the highest -1 the least importance.

5.2 Focus on team states:

a) Cost ranks 8 out of 10
b) Lightweight 7 out of 10
c) Aerodynamic Look, Finish & Strength 5 out of 10
d) Durable 3 out of 10
e) Corrosion Resistant 2 out of 10

2. Target Value-

This is the column where the QFD Team decides if they want to keep their product unchanged and improve the product simultaneous, or make the product better then what the competition does. The value take 1 is least important and 5 is most important.

RELATION MATRIX
9 STRONG
3 MEDIUM
1 WEEK

			TECHNICAL DESCRIPTORS (HOW'S)						
			MATERIAL SLECTION		MANUFACTURING PROCESS				
			PVC PIPE	CAST IRON	WELDING	DIE CASTING	SAND CASTING	FORGING	POWDER METTRULLGY
CUSTOMER REQUIREMENT (WHAT'S)	ASTHETIC	ECONOMICAL COST	1	9	9	3	9	3	1
		AERODYNAMIC LOOK	9	3	9	9	3	3	9
		NICE FINISH	9	3	9	9	1	3	9
		CORROSION RESISTANT	9	1	3	3	3	3	3
	PERFORMANCE	LIGHT WEIGHT	9	1					1
		STRENGTH	3	9	3	3	3	9	13
		DURABLE	9	1	3	9	3	9	3

Table. 1- The Value Obtained By Market Survey And Describe D As Relation Ship Matrix Below Show

Cost	+1
Look	
Finish	
corrosion resistant	
Light Weight	+1
Strength	
Durable	

Cost	8
Look	5
Finish	5
Corrosion Res.	2
Lightweight	7
Strength	5
Durable	3

Our product		Target value
3	cost	4
4	look	4
4	Finish	4
4	Corrosion resistant	4
3	Light weight	4
3	Strength	3
3	Durable	3

3. Scale-up Factor-

The ratio of target value to the our product ranking given in the customer competitive assessment. Ratio of target value to the product rating given in the customer competitive assessment. In this case, Cost and Lightweight had a product rating of 3 and the target value is 4 so scale-up factor is 1.3and 1 to show no further target value.

Cost	1.3
Look	1
Finish	1
corrosion resistant	1
Light Weight	1.3
Strength	1
Durable	1

4. Sale-point-

Customer Requirement will Sell Best Customer Requirement and any other of the customer requirement that will help in the sale of the product. Encourage the Best Customer Requirement and any other of the customer requirement that will help in the sale of the product. Sales Point is a value between 1.0 and 2.0 with 2.0 being the Highest.

In this case, lightweight is the strongest at 2. The cost and Aerodynamic look rank 1.5 and 1 as show do not factor in sale

Cost	1.5
Look	1.5
Finish	1
corrison resistant	1
Light Weight	2
Strength	1
Durable	1

5. Absolute Weight -

After evaluate all the absolute weights, a percent and rank for each customer requirement can be determined.
Absolute Weight = (Importance to the Customer * Scale-Up factor * Sales Point)
(8*1.3*1.5=16)

Cost	16
Look	8
Finish	5
corrosion resistant	2
Light Weight	18
Strength	5
Durable	3

VI. Prioritized Technical Descriptors

This is a block of rows in the foundation of the house corresponding to each technical descriptor. These moderate degree of technical difficulty, target value and absolute and relative weights. The QFD team identifies technical descriptors that are most needed to fulfill customers expectations and need improvement. Table 3 shows the prioritized technical descriptors.

Points to be Consider.

1. Team should consider: Available-technology, Technical-characteristics, Cost, Schedule, Supplier/subcontractor-capability, Manufacturing capabilities, Personnel qualifications
2. Degree of technical difficulty-:The objective of this step is to guide the design, objectively assesses progress.
   Least Difficult = 1 to Most Difficult = 10

The degree of difficulty for welding is 7 and the degree of difficulty for Sand Casing is 3 because it is a much easier manufacturing process-

P.v.c	Cast iron	Welding	Die casting	Sand casting	Forging	Powder metallurgy
6	9	7	4	3	6	9

3. Target Value- This is a objective measure that defines values , must be obtained to achieve the technical descriptors . How much it takes to meet or exceed the customers expectations is answered by evaluating all the information entered into the House of Quality and selecting target values.

P.v.c	Cast iron	Welding	Die casting	Sand casting	Forging	Powder metallurgy
5	5	4	5	0	0	0

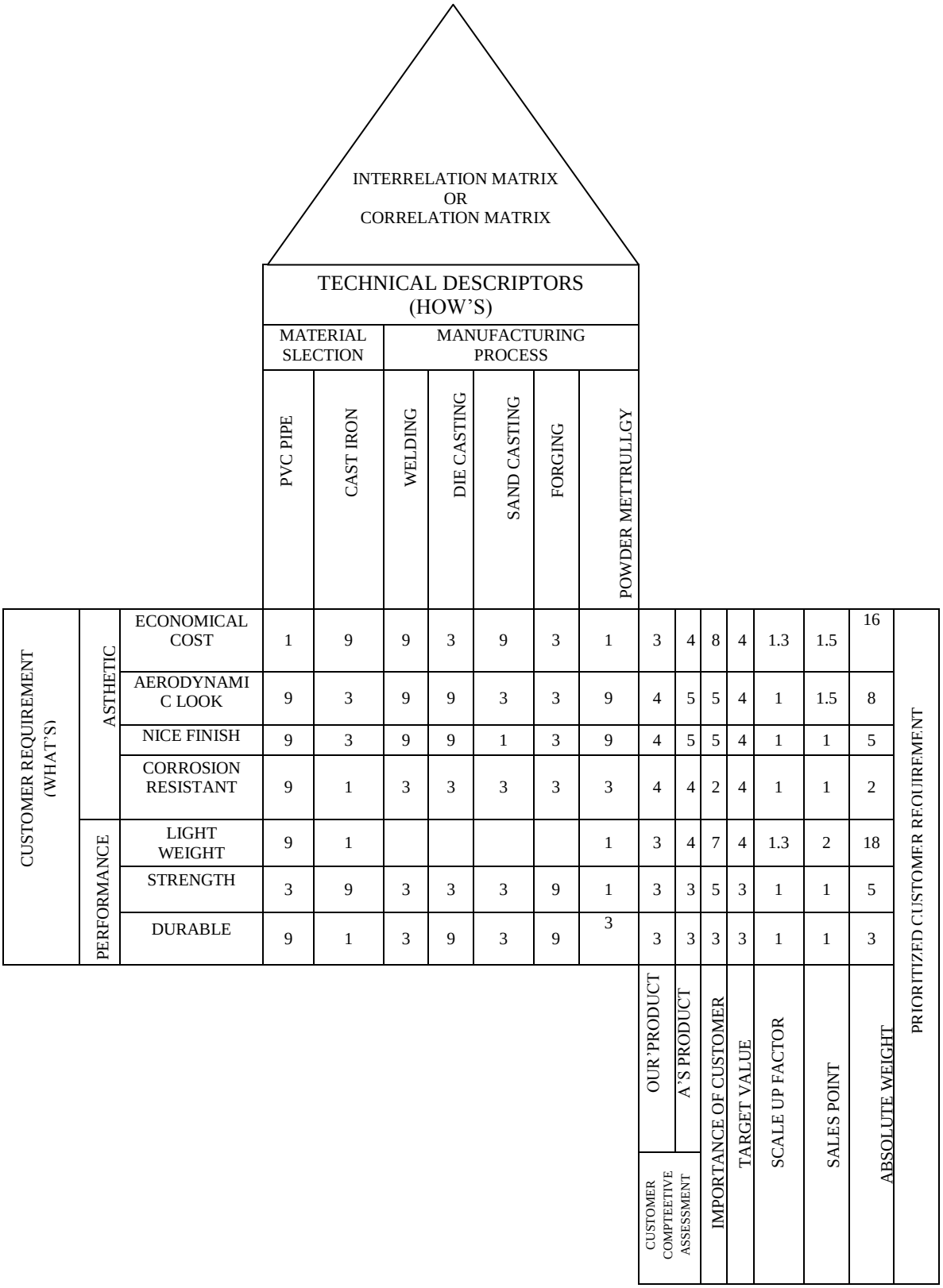


Table. 2- Prioritized Customer Requirement

			TECHNICAL DISCRIPTION (HOW'S)								
			MATERIAL SLECTION		MANUFACTURING PROCESS						
			PVC PIPE	CAST IRON	WELDING	DIE CASTING	SAND CASTING	FORGING	POWDER METTRULLGY		
CUSTOMER REQUIREMENT (WHAT'S)	ASTHETIC	ECONOMICAL COST	R_{11}	R_{12}	R_{13}	R_{14}	R_{15}	R_{16}	R_{17}	C1	D1
		AERODYNAMIC LOOK	R_{21}	R_{22}	R_{23}	R_{24}	R_{25}	R_{26}	R_{27}	C2	D2
		NICE FINISH	R_{31}	R_{32}	R_{33}	R_{34}	R_{35}	R_{36}	R_{37}	C3	D3
		CORROSION RESISTANT	R_{41}	R_{42}	R_{43}	R_{44}	R_{45}	R_{46}	R_{47}	C4	D4
	PERFORMANCE	LIGHT WEIGHT	R_{51}	R_{52}	R_{53}	R_{54}	R_{55}	R_{56}	R_{57}	C5	D5
		STRENGTH	R_{61}	R_{62}	R_{63}	R_{64}	R_{65}	R_{66}	R_{67}	C6	D6
		DURABLE	R_{71}	R_{72}	R_{73}	R_{74}	R_{75}	R_{76}	R_{77}	C7	D7
		ABSOLUTE WEIGHT	a_{j1}	a_{j2}	a_{j3}	a_{j4}	a_{j5}	a_{j6}	a_{j7}	IMPORTANCE OF CUSTOMER	ABSOLUTE WEIGHT OF CUSTOMER REQUIREMENT
		RELATIVE WEIGHT	b_{j1}	b_{j2}	b_{j3}	b_{j4}	b_{j5}	b_{j6}	b_{j7}		

Table. 3- The value observed & calculated then matrix are define

Absolute Weight & Percent-

$$a_j = \sum_{i=1}^{n} R_{ij} c_i$$

Where- a_j =row vector of absolute weights for the technical descriptor (i=1,....m)
R_{ij}=weights assigned to the Relationship Matrix
C_i=column vector of importance for the Customer requirement
m=no. of technical descriptors
n=no.of customer requirement

$$a_{j1}=R_{11}*C1+R_{21}*C2+R_{31}*C3+R_{41}*C4+R_{51}*C5+R_{61}*C6+R_{71}*C7$$

$$a_{j1=}1*8+9*5+9*5+9*2+9*7+3*5+9*3=221$$

Similarly

$$a_{j2}=R_{12}*C1+R_{22}*C2+R_{32}*C3+R_{42}*C4+R_{52}*C5+R_{62}*C6+R_{72}*C7$$

$$a_{j2}=159$$

$$a_{j3}=R_{13}*C1+R_{23}*C2+R_{33}*C3+R_{43}*C4+R_{53}*C5+R_{63}*C6+R_{73}*C7$$

$$a_{j3}=192$$

$$a_{j4}=R_{14}*C1+R_{24}*C2+R_{34}*C3+R_{44}*C4+R_{54}*C5+R_{64}*C6+R_{74}*C7$$

$$a_{j4}=132$$

$$a_{j5}=R_{15}*C1+R_{25}*C2+R_{35}*C3+R_{45}*C4+R_{55}*C5+R_{65}*C6+R_{75}*C7$$

$$a_{j5}=122$$

$$a_{j6}=R_{16}*C1+R_{26}*C2+R_{36}*C3+R_{46}*C4+R_{56}*C5+R_{66}*C6+R_{76}*C7$$

$$a_{j6}=132$$

$$a_{j7}=R_{17}*C1+R_{27}*C2+R_{37}*C3+R_{47}*C4+R_{57}*C5+R_{67}*C6+R_{77}*C7$$

$$a_{j7}=125$$

Relative Weight & Percent-

$$b_j = \sum_{i=1}^{n} R_{ij} d_i$$

Where-b_j =row vector of relative weights for the technical descriptor (j=1,.....m)

R_{ij}=weights assigned to the Relationship Matrix

d_i=column vector of absolute weights for the Customer requirement (i=1,.....n)

m=no. of technical descriptors

n=no.of customer requirement

$$b_{j1}=R_{11}*D1+R_{21}*D2+R_{31}*D3+R_{41}*D4+R_{51}*D5+R_{61}*D6+R_{71}*D7$$

$$b_{j1}=1*16+9*8+9*5+9*2+9*18+3*5+9*3=355$$

Similarly,

$$b_{j2}=R_{12}*D1+R_{22}*D2+R_{32}*D3+R_{42}*D4+R_{52}*D5+R_{62}*D6+R_{72}*D7$$

$$b_{j2}=251$$

$$b_{j3}=R_{13}*D1+R_{23}*D2+R_{33}*D3+R_{43}*D4+R_{53}*D5+R_{63}*D6+R_{73}*D7$$

$$b_{j3}=291$$

$$b_{j4}=R_{14}*D1+R_{24}*D2+R_{34}*D3+R_{44}*D4+R_{54}*D5+R_{64}*D6+R_{74}*D7$$

$$b_{j4}=213$$

$$b_{j5}=R_{15}*D1+R_{25}*D2+R_{35}*D3+R_{45}*D4+R_{55}*D5+R_{65}*D6+R_{75}*D7$$

$$b_{j5}=203$$

$$b_{j6}=R_{16}*D1+R_{26}*D2+R_{36}*D3+R_{46}*D4+R_{56}*D5+R_{66}*D6+R_{76}*D7$$

$$b_{j6}=165$$

$$b_{j7}=R_{17}*D1+R_{27}*D2+R_{37}*D3+R_{47}*D4+R_{57}*D5+R_{67}*D6+R_{77}*D7$$

$$b_{j7}=171$$

VII. Interrelation Matrix Between Hows

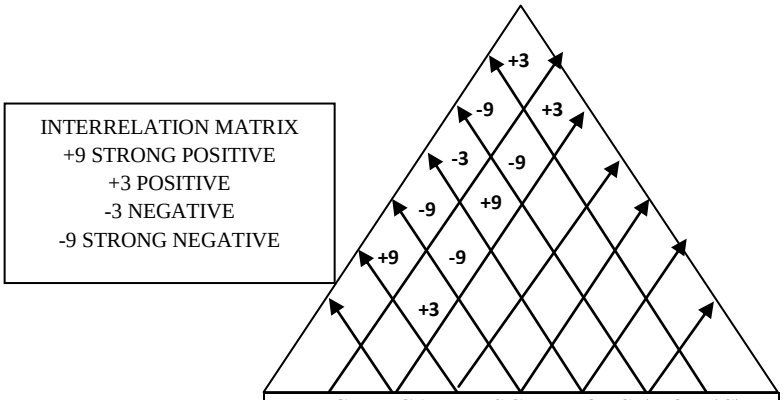
The roof of house of quality called the correlation matrix ,is used to identify any interrelation between each of the technical descriptors .The correlation matrix is a triangular table attached to the technical descriptors , as shown in table 5 below .symbol are used to describe the strength of the interrelationship.

VIII. Results

In plumbing we have applied QFD on different pipes such as p.v.c. or cast iron. In this study, it is formed that the absolute weight or relative weight of p.v.c. Pipe is much higher than the other pipes. There for it is more suitable for the procurement and as shown in the table 4 below

	Absolute weight	Relative weight
P.v.c.	221	355
Cast iron	159	251
Welding	192	291
Die casting	162	213
Sand casting	122	203
Forging	132	165
Powder metallurgy	125	171

Table. 4- Absolute weight vs. relative weight



RELATION MATRIX
9 STRONG
3 MEDIUM
1 WEEK

CUSTOMER REQUIREMENT (WHAT'S)			TECHNICAL DESCRIPTORS (HOW'S)														PRIORITIZED CUSTOMER REQUIREMENT
			MATERIAL SLECTION		MANUFACTURING PROCESS												
			PVC PIPE	CAST IRON	WELDING	DIE CASTING	SAND CASTING	FORGING	POWDER METTRULLGY	OUR'PRODUCT	A'S PRODUCT	IMPORTANCE OF CUSTOMER	TARGET VALUE	SCALE UP FACTOR	SALES POINT	ABSOLUTE WEIGHT	
	ASTHETIC	ECONOMICAL COST	1	9	9	3	9	3	1	3	4	8	4	1.3	1.5	16	
		AERODYNAMIC LOOK	9	3	9	9	3	3	9	4	5	5	4	1	1.5	8	
		NICE FINISH	9	3	9	9	1	3	9	4	5	5	4	1	1	5	
		CORROSION RESISTANT	9	1	3	3	3	3	3	4	4	2	4	1	1	2	
	PERFORMANCE	LIGHT WEIGHT	9	1					1	3	4	7	4	1.3	2	18	
		STRENGTH	3	9	3	3	3	9	1	3	3	5	3	1	1	5	
		DURABLE	9	1	3	9	3	9	3	3	3	3	3	1	1	3	
TECHNICAL COMPTEETIVE ASSESSMENT		OUR PRODUCT	5	0	5	0	0	0	0								
		A'S PRODUCT	0	5	0	0	4	0	0								
DEGREE OF TECHNICAL DIFFICULTY			3	9	4	9	3	9	3								
TARGET VALUE			5	5	4	5	0	0	0								
ABSOLUTE WEIGHT			221	159	192	132	122	132	125								
RELATIVE WEIGHT			355	251	291	213	203	165	171								
			PRIORITIZED TECHNICAL DESCRIPTORS							CUSTOMER COMPTEETIVE ASSESSMENT							

Table. 5- Out Frame in the Form of Matrix

IX. Conclusion

In this work it is observed that QFD plays a deciding role for the relation of plumbing materials where customer and design requirement are properly taken care. PVC plumbing is the best in respect corrosion , welding , aesthetic appearance ,durability easy to operating and maintenance .it is formed that the plumbing cast iron material is three time costlier than the plumbing by p.v.c. Material ,which is very high and uneconomical .PVC material is anti corrosion which is very good for normal liquid flow .

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