A QFD Approach to Improving Vendor Selection Process Through Capturing The Voice Of Customers

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ABSTRACT

Procurement is an industrious and delving task. The main objective of vendor selection process is to reduce risk, maximise win- win situation for the customers and vendors so as to maintain a long term relationship. Due to globalization, many companies are dependent on foreign countries for sourcing and purchasing as a way of making a strategic decision. In this paper, an attempt is made to capture the voice of the customers with intent to unfold various problems faced in vendor selection process and to provide a suitable solution to those problems. The Quality Function Deployment (QFD) technique which used house of quality matrix aided with various statistical analysis tools has been used for assessing the problems faced by various procurement companies and it also provides ways to rectify those problems. The factors contributing to requirements from the customer side are primarily associated with production facility, geographical location, price and 25 other attributes. SPSS and MS Excel software were used as an analysis tool for conducting various tests on the obtained data. From this research project it is found that the major factors like price, adherence to specification, quality and few others top the client's requirements chart and the engineering remedies like -Improvised negotiation and latest innovative technology, Quality time-cost trade-off (major) and a few others are found to make a major impact on the vendor selection process. Further research in the field of developing the techniques in each engineering remedial measure that can be deployed to improve vendor selection process is required as in a way to improve the supply chain management as a whole.

Keywords - Quality Function Deployment (QFD), SPSS (Statistical Package for Social Sciences), Technical specifications, Supply chain management, Quality time-cost trade-off, Production facility.

I. INTRODUCTION

Supply chain management plays an important role in organizing information, resources and activities. Vendor selection process plays an important role in altering the purchase cost and competitiveness. It is found that in construction industry more than 60% of total construction cost accounts for goods and raw materials purchase[1]. Various aspects that are considered important from the customer's point of view (few examples) are listed below:

1. Quality 2. Delivery 3. Price 4. Financial position 5. Technical capabilities 6. Production facility 8. Management and organization 9. Transport and communication 10. After sales service 11. Attitude and willingness 12. Labor relations

Every element in the presented data plays an important role in the vendor selection process and hence it is necessary to understand the significance of each and every aspect before taking a decision in the selection process [2][3]. In this project, improving the vendor selection process is done by capturing the voice of the customers through quality function deployment process which uses the house of quality technique. The various aspects of the customers are taken into account in the quality function deployment method. The main objective of QFD is to translate the customer needs into design requirements [4]. The major client's requirements are obtained through various methods like brainstorming, fuzzy logic, Delphi method, questionnaire survey through focus groups and various other methods like the Analytical Hierarchical Process (AHP) have been used for scoring in QFD [5]. The importance value of every factor is provided in their appropriate boxes which in turn are obtained through questionnaire survey. The fuzzy logic technique is one of the best ways for providing a relationship between the various customer requirements and the techniques or engineering remedies that can be used to overcome those difficulties and to fulfill the requirements [6]. Client-supplier relation plays an important role in any procurement process and the risks associated with them are performance risk and relational risk. Hence in an EPC, the various risk factors have to be taken into account for a better and proper execution of selection process (includes the procurement related cost - a risk related cost and certain cost). Various external supply risk sources have to be taken into account like time window, environmental, political, legal, market, financial etc. [7]. The vendor selection process should be good enough to meet the material management requirement criteria of the client. In construction projects time is an important factor hence many multi-stage manufacturing techniques have been utilized, which provides an opportunity to overcome various problems faced by many construction managers like site inventory, permit, adverse site conditions etc. Transparency and transportation between the owner and vendor play an important role in vendor selection process. Transportation must include cost, safety, timely delivery and hazardous materials content. Material management system helps in ensuring that the quality and quantity of materials is sufficient enough at site and also provides a marginal savings on the cost associated with a project [8].

Hence QFD, a tool which is used in analyzing the various needs with their importance together with the engineering remedies can be a solution and also as a source for improving the vendor selection process. The quality function deployment takes into account the various requirements of the client with their importance and hence, provides a relation between the engineering remedies and the client's requirements with its ranking. Hence QFD is a practical and useful technique for determining, ranking, comparing and providing suitable measures for improving vendor selection process[9].

II. METHODOLODY

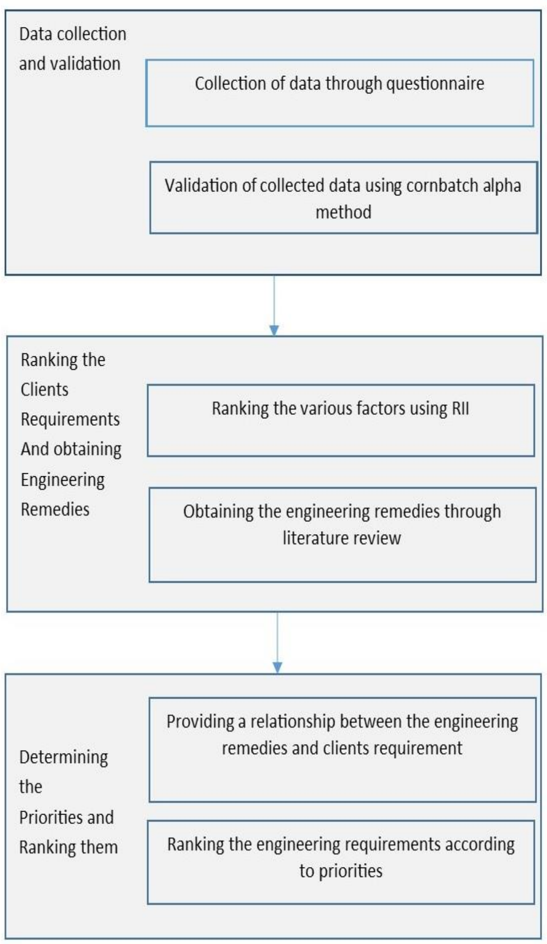

Figure 1: Methodology of this whole project through flowchart

III. DATA COLLECTION, ANALYSIS AND DISCUSSION

Data collection for this project was done through questionnaire survey by direct interview and also through email. People from various designations from civil construction procurement related jobs were selected and data collection was done.

A. Questionnaire preparation and construction

The questionnaire survey was divided into two sections as section 1 and section 2. The section 1 mainly consists of personnel details of the respondent, like the name of the respondent, name of the firm, date of birth, designation, and years of experience. Section 2 consists of the questions related to the various requirements of the client from the vendors. The response to be provided was to be on the Likert scale ranging from 1 to 5 (1 being lowest and 5 being highest). A total of 28 questions which provided information about clients need was prepared and distributed to people in various designations. The Likert scale was used because of its maneuverability and easiness in computing the data and obtaining the required information. A total of 200 questionnaire forms were created and sent, of which 179 returned.

B. Reliability test (corn batch alpha technique)

The Cornbach alpha technique is used as a reliability test tool. Normally the Cornbach alpha value ranges from 0.70 to 0.95. A low value of alpha may suggest that there is low homogeneity between the answers provided by the respondents. The use of this technique for checking the internal consistency of the obtained responses (especially while using Likert scale questionnaire) is favored. [10][11]. The Cornbach value for questionnaire was obtained as 0.963 which is more than 0.6, hence the obtained data through questionnaire is reliable.

C. Relative Importance Index (RII)

For capturing the voice of the customer, the questionnaire was prepared and was sent out to various clients for the response. The response was rated in a 5-point Likert scale from 1 to 5 with notations as follows:

1- Very insignificant
2- Insignificant
3- Significant (mild extent)
4- Significant
5- Highly significant

For this project, RII was used because it best fits the purpose and provided suitable results according to requirements. RII acts as a good validating technique and is also used in ranking the responses according to importance from the client's point of view.

The Formula used for calculating the RII:

$$\mathrm{RII} = \frac{\sum \mathrm{W}}{\mathrm{A} * \mathrm{N}}$$

where,
N- the number of respondents,
W- the weight given to each statement,
A- higher respondent integer.
B- Various factors like the age, education, sex, job, designation etc. was taken into account for this experiment[12][13].

The various factors influencing the vendor selection process from the client's point of view is ranked through relative importance index whose value ranges from 0 to 1. The higher value means a high frequency of response was obtained for that particular element. So from the RII method, it was found that the most important factor that influences the vendor selection is production facility (shown in the Table 2).

D. **Client's requirements with RII and rank**

Table 1: RII values for various clients' requirements

Factors	RII	Rank
Adherence to specification	0.683	17
Price	0.799	2
Delivery schedule	0.689	14
Warranty terms	0.686	15
Payment terms	0.671	22
Performance bank guarantee	0.544	28
Advance bank guarantee	0.453	29
Liquidated damage agreement	0.706	10
Proper communication	0.777	3
Return and exchange policy	0.776	4
Technical support	0.601	25
Quality	0.739	9
Performance history	0.702	12
Technical capabilities	0.669	23
Inventory cost	0.684	16
Insurance schemes (INCOP terms)	0.672	21
Shipment agreement	0.592	26
Production facility	0.837	1
Packaging quality and policy	0.705	11
Business relationship records	0.762	6
Management and organisation policy	0.696	13
Lead and lag time	0.681	18
Geographical location	0.768	5
Service level agreement	0.673	20
Risk factor	0.618	24
Financial position	0.756	7
Labor relationship	0.744	8
Attitude and willingness	0.674	19
Honesty	0.578	27

E. **Top ten client's requirements with RII and rank**

Table 2: Top ten client's requirements with RII

Main Factors	RII	Rank
Production facility	0.837	1
Price	0.799	2
Proper communication	0.777	3
Exchange policy	0.776	4
Geographical location	0.869	5
Relationship record	0.762	6
Financial position	0.756	7
Labor relationship	0.744	8
Quality	0.739	9
Liquidated damage agreement	0.706	10

F. **List of engineering remedies with source**

Table 3: Engineering remedies with source citation

Engineering Remedies	Description	Source
Total quality management (TQM)	TQM improves competitiveness among vendors and hence produces quality products resulting in satisfying clients' needs	[14][15]
Risk management (RM)	Proper Workforce health, safety laws and systems executed with proper utilisation of equipment as in a view to managing and mitigate the risk related to construction industry helps in optimisation of resources usage and producing a quality product.	[16][17]
Global sourcing (GS)	To a certain extent the import of items from global source improves the quality and imparts standards in the vendor selection process.	[18][19][20]
Quality-time-cost trade off (QTCT)	Quality, time and cost – all three together plays an important role in construction industry procurement and these quantities are heavily interrelated. A proper quality-time-cost trade-off would provide optimised results in procurement industry.	[21][22][23]
Green purchase (GP)	Environmentally Preferable Purchasing (EPP) or Green Purchasing helps in reducing the hazardous impact on environment and aids in the reduction of overall construction cost associated in the construction industry by reducing the procurement cost of commodities.	[24][25]
Improvised Negotiation and latest innovative technology (INIT)	The Modern state of the art innovative techniques and principles of the supply chain, e-procurement, sustainability, value engineering and BIM have a huge impact on construction procurement. Automated systems with reasonable time and optimal use of resources while negotiation in the construction industry is found to be efficient in producing quality results.	[26] [27]
Purchase volume (PV)	Purchase volume and mixed feasibilities play an important role in vendor selection procurement performance. Purchase volume has a heavy implication on cost, quality and delivery performance.	[28][29][30]
Multiple sourcing (MS)	To prevent bottlenecks in construction procurement multiple sourcing serves as a fluidized purchasing technique and improves vendor selection process.	[31][32][33]
Supply chain management (SCM)	SCM plays an important role from start to finish. A proper improvised and optimized supply chain can produce quality output.	[34][35][36]
Improvised IT systems (ITS)	Proper data collection and information processing thought improvised information technology processing units (electronic means) reduces the actual cost of construction and produces better quality output.	[37][38]

G. **Quality function deployment**

The main aim of this project is to capture the voice of customers using the house of quality matrix by quality function deployment technique. At present situation the expenditure on exported goods is very high, normally the amount spent is nearly 80% of the total budgeted cost of a project. QFD takes into account the needs of the customers and transforms the needs into the design so as to produce a quality and improved product. This technique is mainly used to impart quality into the design and manufacturing system. The basic steps involved in QFD is as follows

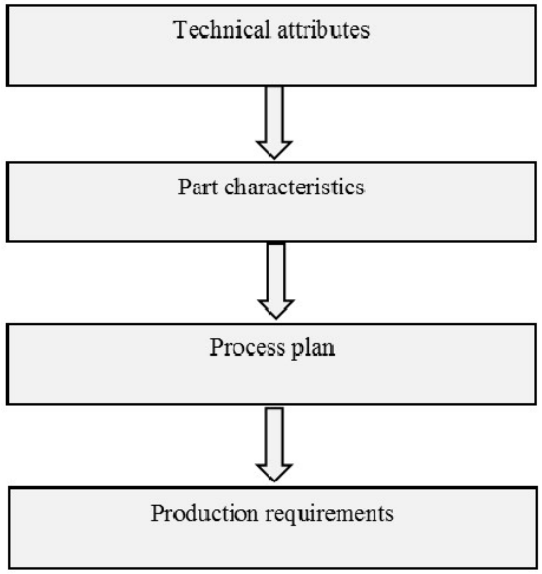

Figure 2: Basic process flow chart of QFD

The main part of quality function deployment is the house of quality, which contains various parts like – what, how, importance, relationship between what and how, inner dependencies, priorities and goals[1][3][39].

H. **House of quality**

The house of quality matrix is where the all the inputs and the outputs and ranking mechanism takes place. In the house of quality the various input elements like the customer requirements with its importance, the engineering remedies, the relationship between them and the final important elements are ranked which in turn are the key elements to be implemented to improve the vendor selection process (particular to this project)[1][40]. A general house of quality matrix construction used in this project is shown below.

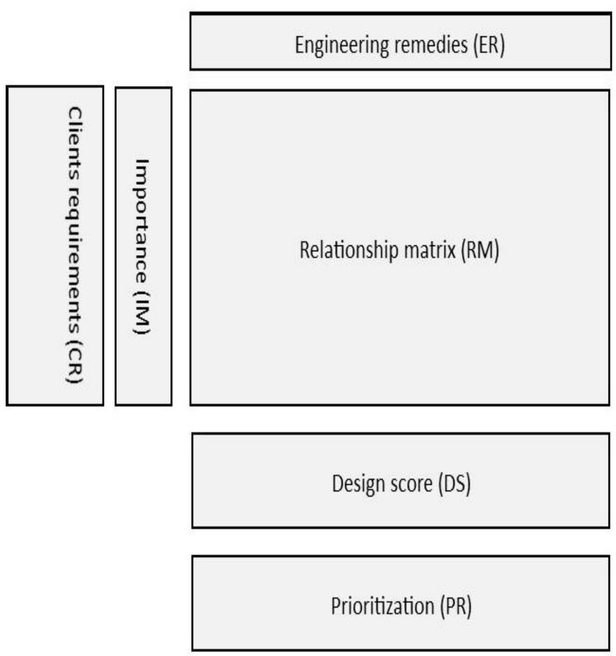

Figure 3: Example house of quality matrix

I. **Correlation relationship matrix with relative importance**

To obtain a correlation between the client's requirements and the engineering remedies, we asked each decision maker expert to evaluate the impact of engineering remedies on client's requirements through direct personal interview. Microsoft excel was used to generalize the results obtained for the correlation between the clients requirements and the engineering remedies. A relationship as strong, medium and weak between what and how is provided with their respective values. With the following points were provided for the relationship[40][41].

Strong – 9 Medium – 5 Weak – 1

The relationship between the customer requirements and the engineering remedies plays an important role in the quality function deployment matrix model. The importance of each design score is computed by calculating the sum of product of client's requirements importance and relationship matrix scores and hence the absolute importance of each design criteria can be computed.

Design importance is computed using the following formula:

$$DI = \sum W * R$$

where W= importance values, R= the relationship value

The value for absolute importance from the relative importance can be calculated using the following formula:

$$RI = \frac{DI}{\sum DI}$$

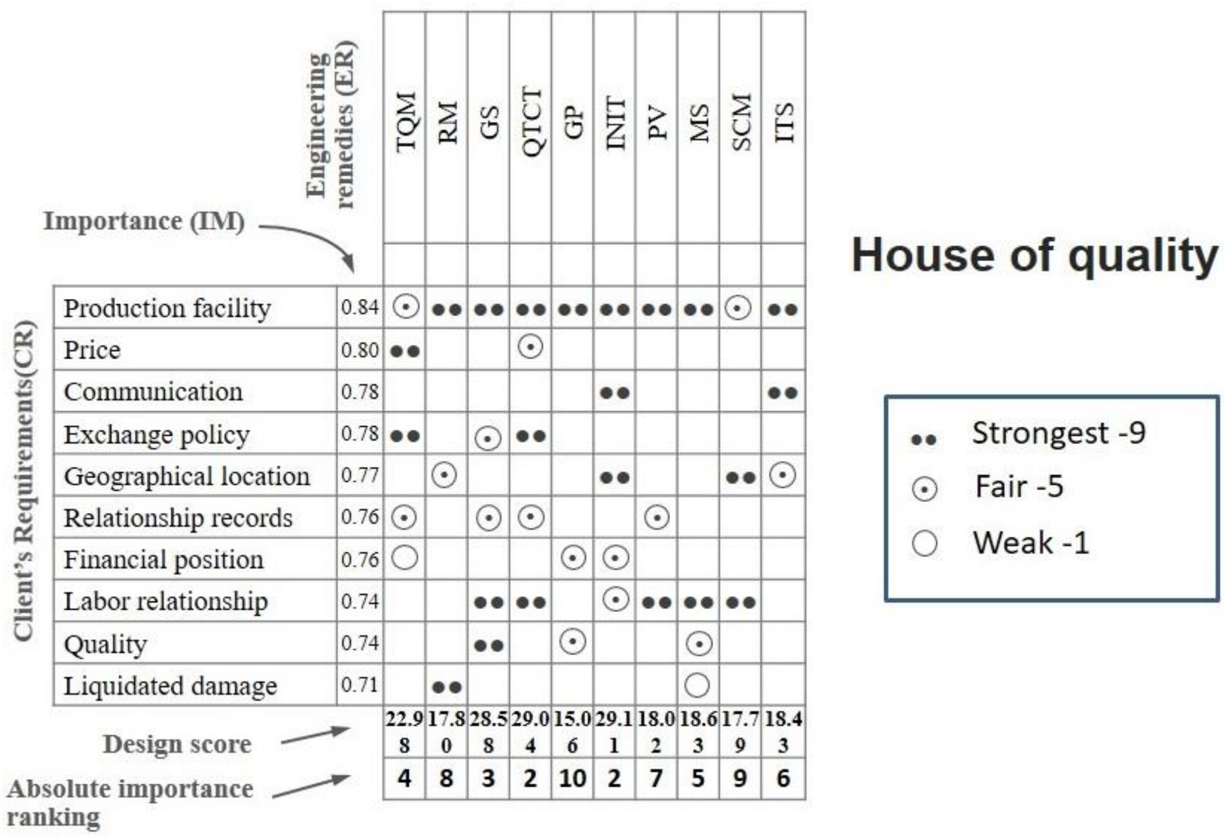

Figure 4: House of quality matrix

IV. CONCLUSIONS AND RESULT

In a competitive market, the importance of proper vendor selection plays a very important part. Various criteria come into play during vendor selection process. In this project, a questionnaire stating the various needs from a client's perspective for vendor selection is taken into account. The questionnaire is sent to 200 respondents of which 179 returned. The few major requirements of the client were found to be-Production facility (topped the list), Price, Communication, Exchange policy and a few more. The engineering remedies that can be used to improve the vendor selection process is obtained from various previous journals as cited above, which are - TQM(total quality management), RM(risk management), GS(green sourcing), QTCT(quality time-cost trade-off) and few more. Fuzzy logic method is used to provide a relationship between client's requirement and the engineering remedies. From the house of quality design, it is found that the main engineering remedies that can be used to improve vendor selection process are improvised negotiation, latest innovative technology, quality time-cost trade-off and others as shown above. Future research can be carried out in finding the particular techniques or methods that can be used for each engineering remedial measures as a way to improvise vendor selection process.

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