Contractors Selection Criteria Framework for Construction Project in Klang Valley

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Malaysia's construction industry is going from strength to strength, with a whole host of newly-announced projects promising to increase activity. Moreover, the construction industry is a very important part of Malaysian economy. The country already has a lot of projects ongoing and under the pipelines, with an ever-changing urban landscape offering plenty of opportunities. The evaluation of project success and the level of success criticality in the development of construction projects in Malaysia are according to the specific requirements and priorities of different project stakeholders and varies from project to project. However, the issues related to maintenance and project functionality are of main concerned to most Government Agencies in Malaysia at the project completion stage apart from client satisfaction on the good services and excellent product deliverables. In the contractor selection stage is commonly used procedure for identifying a pool of competitive, competent and capable contractors from which tenders may be sought. It can aid public and private owners in achieving success by ensuring that only qualified contractor is selected to execute the work. The findings results indicate that several of the criteria highlighted as the most influential criteria of contractor selection for construction project. Another important understanding from the research is that the developing the framework to show the most appropriate ways to select the best contractor for the project. The weightage of each criterion are effective for assessing the technical and commercial tender submission during the tender process. Analysis indicated the top 3 of most influential criteria for contractor selection for construction project in Klang Valley are participation in stakeholders bid process, good tender proposal and method of statement.

***Keywords**:* contractor selection criteria, construction project, performance of contractor

1.0 INTRODUCTION

Construction is one of the Nation's largest industries and it is important for enhancing the industry competitiveness. By construction industry, it is give support to human activities such as shelter, industry, the safety and quality of life of the people, and environmental quality. The construction industry has many fraction which composed not only of companies that actually build structures, but also build the infrastructure to the land to be developed in a particular developing area. According to Wang (1994), as construction industry becoming more sophisticated, a more necessary approach is vital to deal with initiating, planning, financing, designing, approving, implementing and completing the project.

Besides that, construction industry is often considered as a risky business due to its complexity and strategic nature. It incurs a numerous project stakeholder, internal and external factors which will lead to enormous risks. Unfortunately, the construction industry is basically considered to have underperformed compared to the other industries such as UK construction industry has been labeled as not performing at the same level compared to other developed countries. (Takim and Akintoye, 2002).

With increasing complexity and sophisticating of construction projects, further complications have been added to the contractor selection process. This new environment of construction created a need for new methods and tools to help decision makers to make informed decisions. Evaluating the contractor's bid based on price only does not seem to satisfy decision makers anymore. (El-Abbasy *et. al.,* 2013).

A lot of conflicting objectives and alternatives, such as tender price and non-price criteria, financial capabilities, and experience, need to be considered. Recently, to assist clients in making decisions, there has been a trend away from a "lowest-price wins" principle and subjective judgments to a multi-criteria selection approach in the selection of contractors for construction projects. Therefore, the objectives of this research are:

a) To identify the main criteria, ranking and weightage in contractor selection criteria
b) To develop framework of contractor selection for the construction project.

2.0 CRITERIA AFFECTING CONTRACTOR SELECTION

Contractor selection is a commonly used procedure for identifying a pool of competitive, competent and capable contractors from which tenders may be sought. It can aid public and private owners in achieving success by ensuring that only qualified contractor is selected to execute the work (Mills, 2011).

Cheng and Li (2004) concluded that, in terms of contractor selection, the performance of the project will be highly affected when inappropriate methods are used. It is presented that considering the great importance of construction projects in countries and the role of contractors as the most significant executive agents, selecting an appropriate contractor is the most important concern of clients (Bakhshi & Bioki, 2013).

Therefore, in choosing a professional executor, the critical function is that he has unique skills and judgments. An incorrect selection may not only lead to an acrimonious contractor and client relationship but also lead the project to the failure. However, the majority of the past researchers verify that a "price-only" selection of contractor system is inefficient in choosing the most knowledgeable contractors who can execute projects profitably with winning results. Selecting the cheapest bid usually leads to delay, cost over-runs and sub-standard quality and sometimes guides the project to the failure with disputes and escalated claims, etc. (El Wardani et al., 2006; Kumaraswamy, 2006).

As part of this literature findings, the aim is to establish an overview of the selection criteria that have been conducted on this topic previously. This can serve as base point for this research. Eleven (11) academic studies are found on the subject contractor selection criteria and award criteria conducted in the last two decades. The categories 'Firm Characteristics' and 'Past performance & experience' can be described as contractor selection criteria. Whereas, the categories 'Technical Bid' and 'Commercial bid' are award criteria. From this literature, it has determined the criteria to pursues in this research to structure the findings and analysis.

Based on the above, steps have been taken to provide a main and sub-criteria regarding contractor selection including four (4) main criteria which are firm characteristic, past experience and performance, commercial bid and technical bid, represent the needs for a qualified contractor to execute the project and also dividing each of the main criteria to several sub criteria.

Meanwhile, the sub-criteria includes workload capacity, financial position, health, safety and environment, key personnel, project management expertise, organizational experience, past project experience, corporation with other contractor, flexibility when resolving delays, schedule achieved on similar works, tendered price, life-cycle cost, transparency of cost data, cost savings, proposal, participation in stakeholders bid process, method statement, shortest completion date, and subcontracting strategies were respectively introduced.

From literatures findings, the main and sub-criteria affecting the contractor selection are deliberated and established to adopt in this research.

3.0 CONTRACTOR SELECTION CRITERIA METHOD

The research uses several methodologies for the prequalification process. According to Alarcon and Morgues (2002), the interfacing analysis technique offers the highest potential for the tender evaluation stage, because it reduces the possibility of rejecting a good contractor too early and offers scope for rationalization of the selection process, which is pre-qualification stage.

Many methods have been developed previously to improve the current practices of contractor selection and evaluation in many developed countries. Many tools and approaches were developed to assist decision makers in selecting the best contractors for execution of different construction projects. Simulation, Fuzzy Decision Method, and the Multicriteria Decision-Making (MCDM Analytical Hierarchy Process (AHP), Analytical Network Process (ANP), theory are examples of the approaches used to assist in making informed decisions. (El-Abbasy *et al.*, 2013).

The consistency verification operation of AHP contributes greatly to preventing inconsistency because it acts as a feedback mechanism for the decision makers to review and revise their judgments. Consequently, the judgments made are guaranteed to be consistent, which is the basic ingredient for making good decisions and thus is considered the key reason of using the AHP method.

Additionally, most of the models have a weakness in identifying the relative weights, which usually require the relative weights to be decided in an earlier stage by other models. However, it is found that the most accurate and easy method for identifying the relative weight is AHP. Some of the above methods are based on the contractor's financial stability such models and this measurement is one of the disadvantages of the construction selection. Moreover, some models are complex and require an amount of historical data, such as Fuzzy set methods whereby in those models the user should acquire extensive mathematical background and it could be hard to collect, to understand and run the analysis. On the other hand, with the AHP just a few numbers are required.

As seen in comparison of the existing models, the AHP will be selected as the decision maker's tool. AHP can determine the best and the worst ideal solution. AHP method has shown good results in exploiting the decision information and objectively assigning weights to the primary decision attributes, especially being well applied in area of contractor selection of large scale construction projects. Further, the most positive advantage is that AHP are reliable and systematic techniques as they have the ability to capture an expert's judgment when complex MCDM struggles are considered (Lin et al., 2008).

Pursuing from the literatures findings, the contractor selection criteria are determined and used in this research as to reinforce the existing findings.

4.0 RESEARCH METHODOLOGY

To identify the importance of each criterion—being a main or a sub criterion—in the selection process, the questionnaire used in form of pair-wise comparison method. The comparison was conducted on three levels, as follows:

a) Comparison among main criteria with respect to contractor selection;
b) Comparison among sub criteria within each main criterion; and
c) Comparison among main criteria with respect to one another.

The three level of comparison to be made to create an inner interdependency between each cluster of criteria, AHP is structures a decision problem into a hierarchy with a goal, decision criteria, and alternatives, while the ANP structures it as a network. Both then use a system of pairwise comparisons to measure the weights of the components of the structure, and finally to rank the alternatives in the decision. (El-Abbasy *et. al*, 2010)

The aforementioned third level is one of the main features that ANP adds to the well-known AHP method, in which it allows to create an inner interdependency. The three levels can also be illustrated as shown in **Fig. 1**. The pair-wise comparison for each level was designed in a very simple way in which each respondent decides based on his/her own experience the degree of importance of each criterion (X) or (Y) over the other(s) with respect to the goal under question.

The degree of importance is scaled from 1–9. An assigned value of 1 indicates that there is no significant importance of a criterion over the other, whereas a value of 9 indicates that there is an absolute importance for a criterion over the other, as shown in **Table 1**.

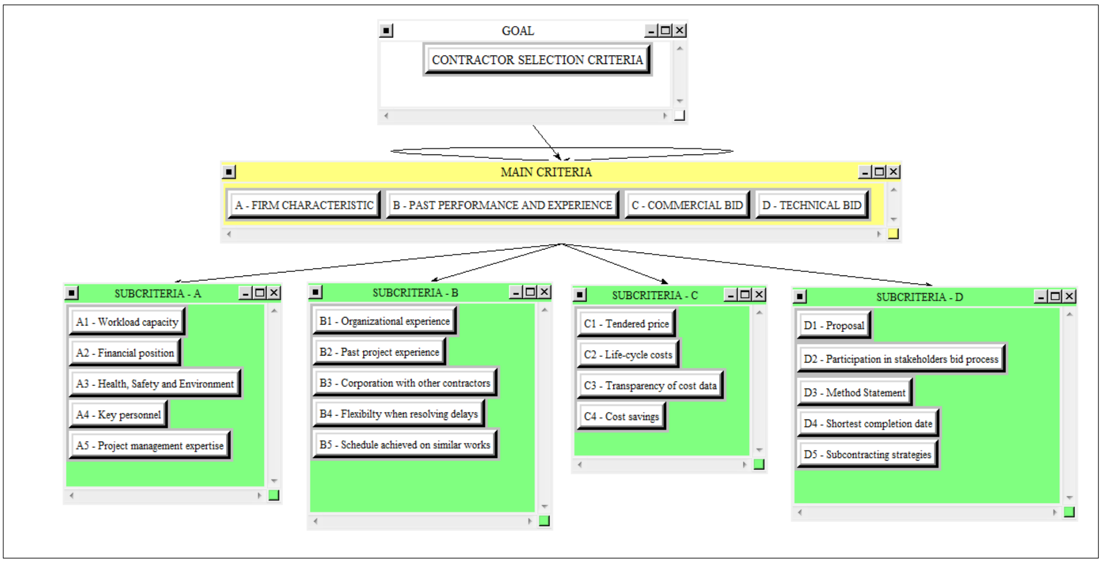


Figure 1: ANP network hierarchy by using @Super Decision Software

Table 1: Pair-wise comparison scale for AHP preferences (Jiang *et al*, 2010)

Intensity	Definition	Explanation
1	**Equal importance**	Two elements contribute equally to the objective
3	**Moderate importance**	Experience and judgement slightly favor one element over another
5	**Strong importance**	Experience and judgement strongly favor one element over another
7	**Very strong importance**	One element is favored very strongly over another, it dominance is demonstrated in practice
9	**Absolute importance**	The evidence favoring one element over another is of the highest possible order of affirmation

The steps of the ANP process were followed to determine the final global weights of selection criteria using the data collected through questionnaires. The implementation of the ANP process is briefly illustrated using the following seven steps. (El-Abbasy *et.al.*, 2013)

1. Employing the pair-wise comparisons. The elements of each level of network hierarchy were rated using the pair-wise comparison according to Saaty's (1996) scale of measurement mentioned previously. After all elements have been compared with the priority scale pair by pair, a paired comparison matrix was developed.

2. Estimating relative weights. After the pair-wise comparison matrix was developed, a vector of priorities in the matrix was calculated and then normalized to sum to 1.00 or 100%. This was done by dividing the elements of each column of the matrix by the sum of that column (i.e., normalizing the column). Elements of each resulting row were added to obtain a row sum and then divided by the number of elements in the row to obtain the relative weight or priority.

3. Determining Consistency Ratio (CR). Because humans are sometimes inconsistent in answering questions, CR was used to validate the results and measure the consistency in the pair-wise comparison process. Saaty (1994) set acceptable CR values for different sizes of matrices.

4. Developing the unweighted supermatrix. With interdependent influence, the system consisting of cluster and subcluster matrices was translated into a two-dimensional supermatrix. The nodes grouped by the clusters they belong to, were the labels of rows and columns of the supermatrix. The supermatrix is not presented because of paper size limitations.

5. Developing the weighted supermatrix. The weighted supermatrix was obtained by dividing each entry in each row in the unweighted supermatrix by the total summation of its relative intersecting column.

6. Developing the limit supermatrix. After entering the submatrices into the supermatrix and completing the column to determine the weighted supermatrix, it is then raised to a sufficiently large power until convergence occurs to obtain the limit supermatrix. It is noted that the number in all columns of the limit supermatrix are identical because of convergence.

7. Calculating final global weights. From the limit super matrix, the final weights could be obtained by proportioning the elements of each cluster to themselves. To facilitate the application of the previously discussed steps, Super Decisions software was used. The network's components and relations were identified as shown in Fig. 1 and then the pair-wise comparison for each level was entered.

This research adopts the pair-wise comparison to determine the level of intensity how the criteria selection is measured. Subsequently, Global Weight analysis is used to analyse the influential criteria's ranking over data collected from the findings.

In this research, the coding/tagging A, B, C and D are used to represent the most influential main criteria's ranking tabulated in Table 6. Whereas, the coding system A1, A2, A3, 14, A5, B1, B2, B3, B4, B5, C1, C2, C3, D1, D2, D3, D5 are represent the most influential sub-Criteria's ranking in order to differentiate the normalized matrix over idealized matrix for each criteria which explained in Chapter V and tabulated in **Table 7**.

5.0 RESULTS AND DISCUSSION

The findings on critical criteria influencing the construction project in this research is used as basis in establish the framework. The data is analysed and discussion on the findings to complement the objectives of the research. The data obtained based on the returned questionnaire survey distributed to respondents with a certain response rate. Besides that, based on the return questionnaire survey template, the respondents are classified according to their position and the working experience in the industry. The data is analysed and discusses further to give a more distinct view of issues within the construction industry.

The elements of each level of network hierarchy were rated using the pair-wise comparison scale of measurement as mentioned. Subsequently, all elements have been compared with the priority scale pair by pair, a paired comparison matrix then was developed as per **Figure 2**.

Figure 2: Part of Pair-wise comparisons process by using @Super Decision software.

After the pair-wise comparison matrix was developed, a vector of priorities in the matrix was calculated and then normalized to sum to 1.00 or 100%. This was done by dividing the elements of each column of the matrix by the sum of that column (i.e., normalizing the column). Elements of each resulting row were added to obtain a row sum and then divided by the number of elements in the row to obtain the relative weight or priority as shown in the **Table 2.**

Table 2: Vector of Priorities of Criteria Normalized by Cluster

Name	Normalized By Cluster	Limiting
CONTRACTOR SELECTION CRITERIA	0	0
A - FIRM CHARACTERISTIC	0.02612	0.005224
B - PAST PERFORMANCE AND EXPERIENCE	0.07927	0.015854
C - COMMERCIAL BID	0.21575	0.04315
D - TECHNICAL BID	0.67886	0.135773
A1 - Workload capacity	0.35041	0.070082
A2 - Financial position	0.30983	0.061967
A3 - Health, Safety and Environment	0.31813	0.063626
A4 - Key personnel	0.00578	0.001156
A5 - Project management expertise	0.01585	0.00317
B1 - Organizational experience	0.48744	0.097487
B2 - Past project experience	0.48807	0.097613
B3 - Corporation with other contractors	0.00274	0.000548
B4 - Flexibilty when resolving delays	0.00656	0.001311
B5 - Schedule achieved on similar works	0.01521	0.003041
C1 - Tendered price	0.32531	0.065062
C2 - Life-cycle costs	0.3267	0.065339
C3 - Transparency of cost data	0.33026	0.066052
C4 - Cost savings	0.01773	0.003546
D1 - Proposal	0.248	0.0496
D2 - Participation in stakeholders bid process	0.25206	0.050413
D3 - Method Statement	0.24628	0.049257
D4 - Shortest completion date	0.24735	0.049471
D5 - Subcontracting strategies	0.0063	0.00126

CR was used to validate the results and measure the consistency in the pair-wise comparison process. The CR values were calculated for all matrices, which showed all of them to be consistent within the range of 0.00274 to 0.67886. The **Table 3** shows how the inconsistency in the answering the questions solved by conducting normalization and idealization process.

Table 3: The result and measure the consistency in the pair-wise comparison process

Inconsistency	0.47095	
Name	**Normalized**	**Idealized**
A - FIRM CHARACTERISTIC	0.026120178	0.03847631
B - PAST PERFORMANCE AND EXPERIENCE	0.079268052	0.11676574
C - COMMERCIAL BID	0.215747839	0.31780719
D - TECHNICAL BID	0.678863932	1
Inconsistency	**0.2727**	
Name	**Normalized**	**Idealized**
A1 - Workload capacity	0.025950999	0.04100741
A2 - Financial position	0.027278884	0.04310571
A3 - Health, Safety and Environment	0.095762813	0.15132306
A4 - Key personnel	0.218170408	0.34474982
A5 - Project management expertise	0.632836896	1
Inconsistency	**0.45295**	
Name	**Normalized**	**Idealized**
B1 - Organizational experience	0.018997522	0.0326341
B2 - Past project experience	0.04307035	0.07398661
B3 - Corporation with other contractors	0.104852584	0.18011666
B4 - Flexibilty when resolving delays	0.250942472	0.43107111
B5 - Schedule achieved on similar works	0.582137072	1
Inconsistency	**0.47095**	
Name	**Normalized**	**Idealized**
C1 - Tendered price	0.026120178	0.03847631
C2 - Life-cycle costs	0.079268052	0.11676574
C3 - Transparency of cost data	0.215747839	0.31780719
C4 - Cost savings	0.678863932	1
Inconsistency	**2.16207**	
Name	**Normalized**	**Idealized**
D1 - Proposal	0.173347382	0.52682701
D2 - Participation in stakeholders bid process	0.329040424	1
D3 - Method Statement	0.107753704	0.32747862
D4 - Shortest completion date	0.148648903	0.45176486
D5 - Subcontracting strategies	0.241209588	0.73306977

The result shows that the different of matrix between normalized matrix over idealized matrix for each main criteria and sub-criteria. The inconsistencies are within range of 0.2727 to 2.16207. The sub-criteria A5, B5, C4 and D2 shows balance of consistency with the matrix of 1 respectively. It shows that those criteria most selected by the respondent as the most influential criteria for each sub-criteria.

After entering the submatrices into the supermatrix and completing the column to determine the weighted supermatrix, it is then raised to a sufficiently large power until convergence occurs to obtain the limit supermatrix. **Table 4** show that the number in all columns of the limit super matrix are identical because of convergence. Refer to Appendix C for complete set of several of supermatrix of this research.

Table 4: Part of Various Types of Supermatrix

		Unweighted supermatrix					Weighted supermatrix					Limit supermatrix				
		Main Criteria					Main Criteria					Main Criteria				
With respect to		Goal	A	B	C	D	Goal	A	B	C	D	Goal	A	B	C	D
Goal		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Main Criteria	A	0.026120	1.000000	0.000000	0.000000	0.000000	0.026120	0.200000	0.000000	0.000000	0.000000	0.005224	0.200000	0.000000	0.000000	0.000000
	B	0.079268	0.000000	1.000000	0.000000	0.000000	0.079268	0.000000	0.200000	0.000000	0.000000	0.015854	0.000000	0.200000	0.000000	0.000000
	C	0.215748	0.000000	0.000000	0.200000	0.000000	0.215748	0.000000	0.000000	0.200000	0.000000	0.043150	0.000000	0.000000	0.200000	0.000000
	D	0.678864	0.000000	0.000000	0.000000	0.200000	0.678864	0.000000	0.000000	0.000000	0.200000	0.135773	0.000000	0.000000	0.000000	0.200000
Subcriteria (A)	A1	0.000000	0.000000	0.652174	0.066667	0.066667	0.000000	0.038900	0.130435	0.066667	0.066667	0.070082	0.003890	0.130435	0.066667	0.066667
	A2	0.000000	0.049503	0.130435	0.066667	0.066667	0.000000	0.009901	0.026087	0.066667	0.066667	0.061967	0.009901	0.026087	0.066667	0.066667
	A3	0.000000	0.103045	0.217391	0.066667	0.066667	0.000000	0.020609	0.043478	0.066667	0.066667	0.063626	0.020609	0.043478	0.066667	0.066667
	A4	0.000000	0.221275	0.000000	0.000000	0.000000	0.000000	0.044255	0.000000	0.000000	0.000000	0.001156	0.044255	0.000000	0.000000	0.000000
	A5	0.000000	0.606729	0.000000	0.000000	0.000000	0.000000	0.121346	0.000000	0.000000	0.000000	0.003170	0.121346	0.000000	0.000000	0.000000
Subcriteria (B)	B1	0.000000	0.018998	0.500000	1.000000	0.100000	0.000000	0.003800	0.100000	0.100000	0.100000	0.097487	0.003800	0.100000	0.100000	0.100000
	B2	0.000000	0.043070	0.500000	1.000000	0.100000	0.000000	0.008614	0.100000	0.100000	0.100000	0.097613	0.008614	0.100000	0.100000	0.100000
	B3	0.000000	0.104853	0.000000	0.000000	0.000000	0.000000	0.020971	0.000000	0.000000	0.000000	0.000548	0.020971	0.000000	0.000000	0.000000
	B4	0.000000	0.250942	0.000000	0.000000	0.000000	0.000000	0.050188	0.000000	0.000000	0.000000	0.001311	0.050188	0.000000	0.000000	0.000000
	B5	0.000000	0.582137	0.000000	0.000000	0.000000	0.000000	0.116427	0.000000	0.000000	0.000000	0.003041	0.116427	0.000000	0.000000	0.000000
Subcriteria (C)	C1	0.000000	0.026120	0.333300	0.066667	0.066667	0.000000	0.005224	0.066667	0.066667	0.066667	0.065061	0.005224	0.066667	0.066667	0.066667
	C2	0.000000	0.079268	0.333300	0.066667	0.066667	0.000000	0.015854	0.066667	0.066667	0.066667	0.065339	0.015854	0.066667	0.066667	0.066667
	C3	0.000000	0.215748	0.333300	0.066667	0.066667	0.000000	0.043150	0.066667	0.066667	0.066667	0.066052	0.043150	0.066667	0.066667	0.066667
	C4	0.000000	0.678864	0.000000	0.000000	0.000000	0.000000	0.135773	0.000000	0.000000	0.000000	0.003546	0.135773	0.000000	0.000000	0.000000
Subcriteria (D)	D1	0.000000	0.173347	0.250000	0.050000	0.050000	0.000000	0.034669	0.050000	0.050000	0.050000	0.049600	0.034669	0.050000	0.050000	0.050000
	D2	0.000000	0.329040	0.250000	0.050000	0.050000	0.000000	0.065808	0.050000	0.050000	0.050000	0.050413	0.065808	0.050000	0.050000	0.050000
	D3	0.000000	0.107754	0.250000	0.050000	0.050000	0.000000	0.021551	0.050000	0.050000	0.050000	0.049257	0.021551	0.050000	0.050000	0.050000
	D4	0.000000	0.148649	0.250000	0.050000	0.050000	0.000000	0.029730	0.050000	0.050000	0.050000	0.049471	0.029730	0.050000	0.050000	0.050000
	D5	0.000000	0.241210	0.000000	0.000000	0.000000	0.000000	0.048242	0.050000	0.000000	0.000000	0.001260	0.048242	0.000000	0.000000	0.000000

The result shows that goal matrices in the row of limit supermatrix will get the total value of 1, which is to predetermine the local weightage for each main criteria and sub-criteria. The highest limit supermatrix is for main criteria D (commercial bid) and the range highest value of 0.001156 (corporation with other contractors) to lowest value of 0.097487 (past project performance).

From the limit super matrix, the final weights could be obtained by proportioning the elements of each cluster to themselves. To facilitate the application of the previously discussed steps, @Super Decisions software was used. The network's components and relations were identified and then the pair-wise comparison for each level was entered.

As shown in **Table 5**, the cluster of main criteria is contractor's firm characteristic, past experience and performance, technical bid and commercial bid with matrix values of 0.005224, 0.015854, 0.043150, and 0.135773, respectively, which results in a total matrix value of 0.20. Therefore, all matrices were calculated by divided each of these values by 0.20 for the final matrix weights.

The same procedure was followed with each sub criteria cluster to obtain the local weight, which was then multiplied by the final weights of each corresponding main criteria to obtain the global weight.

Table 5: Average Final Local and Global Weights for Main and Sub criteria

Main Criteria	Global Weight (%)	Subcriteria		Local weight (%)	Global weights (%)
(A) Firm Characteristic	2.61	A1 :	Workload Capacity	31.0	0.92
		A2 :	Financial Position	31.8	0.81
		A3 :	Health, Safety and Environment	0.6	0.83
		A4 :	Key Personnel	1.6	0.02
		A5 :	Management Personnel	48.7	0.04
(B) Past Experience & Performance	7.93	B1 :	Organizational Experience	1.6	3.86
		B2 :	Past Project Performance	48.7	3.87
		B3 :	Corporation when resolving delay	48.8	0.02
		B4 :	Corporation with other contractors	0.3	0.05
		B5 :	Schedule achieved on similar works	0.7	0.12
(C) Technical Bid	21.58	C1 :	Tendered Price	32.5	7.02
		C2 :	Life Cycle Costing	32.7	7.05
		C3 :	Transparency of cost data	33.0	7.13
		C4 :	Cost saving	1.8	0.38
(D) Commercial Bid	67.89	D1 :	Proposal	24.8	16.84
		D2 :	Participation in stakeholders bid process	25.2	17.11
		D3 :	Method statement	24.6	16.72
		D4 :	Shortest completion period	24.7	16.79
		D5 :	Subcontracting strategies	0.6	0.43

The result shows the local and global weights of each main criteria and sub-criteria for contractor selection. The high weightage represents the importance of that criterion compared to the others in selecting the best contractor for the project. Meanwhile, the low weightage represents the least importance, but the client should not hinder that criterion at all, but give some consideration to the contractors who least convincing on the area of evaluation, by contradict to their less convincing result to their technical and commercial bid in the same time.

Based on the result of global weight of each main criterion, the main criteria which has highest global weight is commercial bid (67.89%), follow by technical bid (21.58%), past experience and performance (7.93%), and firm characteristic (2.61%). The sub-criteria which among the highest global weight are participation of in shareholders bid process (17.11%), followed by proposal (16.84), shortest completion period (16.79%), method statement (16.72%), transparency of cost data (7.13%), life-cycle costing (7.05%), tendered price (7.02%), project past experience (3.87%), and organizational experience (3.86%).

The brief explanation on every main criteria and sub-criteria are described, simplified and ranked as **Table 6** and **Table 7** respectively.

Table 6: The Most Influential Main Criteria's ranking

No.	Main Criteria	Explanation	Global Weight (%)	Ranking
D	Commercial Bid	Focus on the competitiveness of price offered value management and cost saving, and commercial value of the proposal.	**67.89**	**1**
C	Technical Bid	Focus on the technical capabilities, number of resources, commitment to fulfill client requirements, and promising tendency to perform well in the project.	**21.58**	**2**
B	Past Experience	Focus on the overall performance of previous project which is similar in nature to the proposed project and potential for future projects.	**7.93**	**3**
A	Firm Characteristic	Focus on the establishment of tenderers in the construction work industry, current workload, financial capabalities and company reputation.	**2.61**	**4**

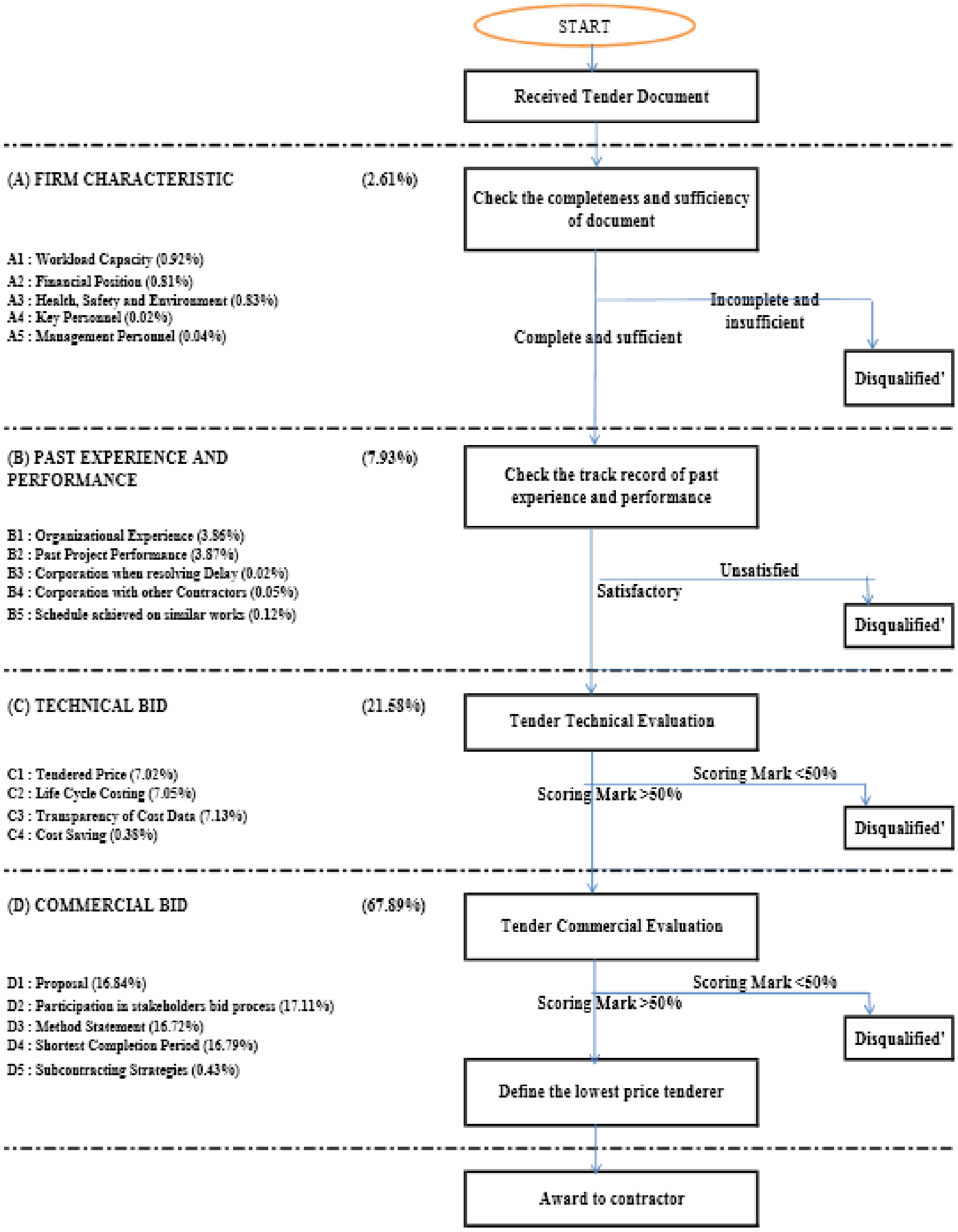
Table 7: The Most Influential Sub-Criteria's Ranking

No.	Sub-Criteria	Explanation	Global Weight (%)	Ranking
D2	Participation in stakeholders bid process	The tenderers show high commitment in the bid process, and the proposal offered initiating the beneficial to the client and other stakeholder in the project.	**17.11**	**1**
D1	Proposal	The tenderers offer the detail proposal of site organizational and work program, including proper site planinng, safety policy, and quality control and assurance procedures.	**16.84**	**2**
D3	Method statement	The tenderers provide detail approved method of statement and specification for every works and trades involved in the proposed project.	**16.72**	**3**
C3	Transparency of cost data	The tenderers offer their best competitive prices which is no additional hidden cost, highlighted the missing items to client and cost it wisely.	**7.13**	**4**
C2	Life cycle costing	The tenderers proposed their best alternative material and method, which is could contribute to less cost of maintenance of works after completion.	**7.05**	**5**
C1	Tendered price	The tenderers offer their best competitive prices which is highly reasonable and accurate to current market rate.	**7.02**	**6**
B2	Past project performance	The tenderers have good track record which is completed the works within stipulated reasonable time and cost.	**3.87**	**7**
A1	Workload capacity	The tenderers have current project which are the value of works is higher than proposed project	**0.92**	**8**
A3	Health Safety Environment	The tenderers have proper health, safety and environment policies and procedures, supported with quality assurance certification.	**0.83**	**9**
A2	Financial Position	The tenderers achieved highly turnover rate within past three years, good current financial standing and credit facilities.	**0.81**	**10**
D5	Subcontracting strategies	The tenderers proposed the best subcontracting and procurement strategies, which could contribute to cost saving to client and shorter duration of works.	**0.43**	**11**
C4	Cost saving	The tenderers proposed their best alternative material and method, which is could contribute to cost reduction and value for money to the client	**0.38**	**12**
B5	Schedule achieved on similar works	The tenderers have good record in completing the works without delay in previous works which is similar in nature.	**0.12**	**13**
B4	Corporation with other contractors	The tenderers have good record and relationship with previous other contractor in the same project, resulting smooth project delivery.	**0.05**	**14**
A5	Management personnel	The tenderers proposed the technically competence project management team for the proposed project	**0.04**	**15**
A4	Key Personnel	The tenderers proposed the highly qualified and experienced person as project manager for the proposed project.	**0.02**	**16**
B3	Corporation when resolving delay	The tenderers have good record and relationship with other previous clients, resulting successful completion of works without delay.	**0.02**	**17**

From the Global Weight analysis, it reveals that the most criteria incline to be adopted in selection criteria is the participation in stakeholders bid process which contributes to 17.11% followed by proposal and method statement. Hence, the commitments demonstrated by the tenderer winning the tender is the most concerns in the selection criteria.

The final objective of this research is to develop suitable framework in order to obtain the systematic approach in the contractor selection.

The common practice in the client's office is to have the simple comparison based on the experience and the price offered by the contractor in the tender process, instead to have the reliable weightage of criteria in their evaluation and assessment of the contractors. From the findings and discussion, the systematic Framework is established in each stages of assessment as a guiding tools in selecting the most appropriate contractor with the lowest bidding price for the construction industry.



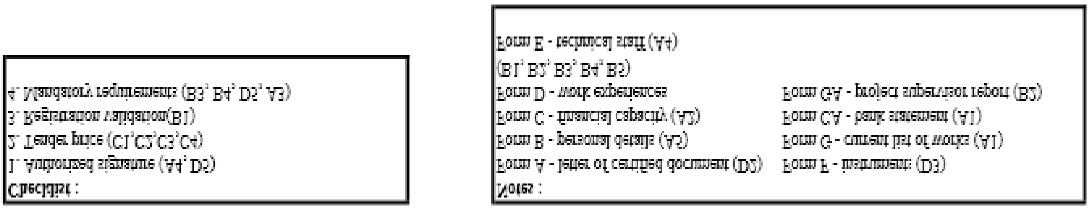


Figure 3: The framework for contractor selection

6.0 CONCLUSION

The finding results indicate that several of the criteria highlighted as the most influential criteria of contractor selection for construction project. Another important understanding from the research is that the developing the framework to show the most appropriate ways to select the best contractor for the project. The weightage of each criterion are effective for assessing the technical and commercial tender submission during the tender process.

Analysis indicated the top 10 of most influential criteria for contractor selection for construction project in Klang Valley as following:

i. Participation in stakeholders bid process
ii. Proposal
iii. Method Statement
iv. Transparency of cost data
v. Life Cycle Costing
vi. Tendered Price
vii. Past project performance
viii. Workload Capacity
ix. Health, Safety and Environment
x. Financial position

It is also understood that all responsible parties' plays an important role to ensure the awarded contractor could deliver the project to the specified time, quality, and cost as the client requirement. Out of various criteria considered in the research, all parties should give feedback on the result of contractor's performance in their project, so that the input would become the reference for their future projects.

7.0 RECOMMENDATION

Based on the conclusion of this research, the recommendation for future research shall take much wider approach especially in term of data collection and results analysis for future research, several recommendations are made. First, expand the distribution of questionnaire to wider area of research. Therefore, future studies of contractor selection criteria should utilize adequate sample sizes of the respondent to achieve accurate data to analyze. Secondly, larger sample sizes from different type of project such as infrastructure, power plant, offshore and marine structure, and etc.

Another recommendation is in term of data collection which is can be improved by online survey software as an interactive tool for editing and analyzing all sorts of data and feedback such as using Statistical Package for the Social Sciences (SPSS). Lastly, to achieve a better understanding on the contractor selection criteria and to conclude in more meticulous way, careful planning and organizing the questionnaire structure is the most important stage to get the most reliable result of the research. As a conclusion, for further research could be pursued by replicating this reseach in other type of project using more comprehensive research methodology.

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