CONTRACTOR PRE-QUALIFICATION

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Abstract:

One of the most cases of complexity in the construction industry is the selection of the appropriate contractor. This summary thesis investigates the concepts of contractor per-qualification requirements. It has three major parts. The first part deals with the nature of PQ and the necessity/benefit of conducting PQ prior to bidding. PQ methodology and how to apply rating strategies are presented on the second part. Eventually, mathematical modes techniques with sample calculations are listed in the third part. The main purpose of this mathematical/statistical analysis is to eliminate or minimize the subjectivity in selection of qualified contractors.

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Chapter 1

INTRODUCTION

A successful construction program can occur only if it is performed by a combination of capable and knowledgeable people. The goal in construction, from point of view of the owner, is to provide him with appropriate facilities representing an effective and efficient expenditure of his money. A qualified contractor will minimize problems and complete the project according to the owner's expectations. However, if that contractor is not qualified by experience, skill, integrity, and responsibilities, and does not have the financial means to provide a completed project, the result will be disappointing.

Contractor pre-qualification means screening construction contractors according to a pre determined set of criteria in order to determine their competence or ability to participate in the project bid.

PROBLEM STATEMENT:

In the case of public project, the contract is normally given to the lowest responsible bidder in a competitive bidding delivery system. However, a major problem may arise in the public sector during the competitive bidding phase, this problem is to determine the responsibility of the contractor and his ability to perform the owner's project. Therefore, depending solely of the lowest price is not warranted approach. Beside that, the public owner bases his decision on subjective judgment, which does not follow a sequential structured approach to determine short-listed qualified contractors.

Responsible bidder refers to more than the capacity, skill, reliability, and integrity of the bidder. The awarding authorities should verify that the bidder:

1. Has adequate financial resources, experience, personnel resources, and equipment to perform the task.
2. Has the ability to comply with the required performance and time schedule.

The responsible contractor may be required to vouch for the responsibility of his subcontractors as well as his material suppliers. It should be realized that using a pre-qualification questionnaire alone does not mean using a strategy for per-qualification because it is only a means of gathering information needed for evaluation. Ensuring contractors characteristics and capabilities matching the requirements of the project under consideration is significant step.

PRE-QUALIFICATION BENEFITS TO PUBLIC PROJECTS:

The contractor will benefit by assurance that he will be on a reasonable even basis with his competition. Moreover, both the owner and A/E benefit through the problems elimination of selecting unqualified contractor. Other advantages are:

- Assuring that the low prime bidder and his major subcontractors will be competent to handle the task without becoming overburdened.
- Eliminating the contractors who have limited financial resources or experience.

- Controlling the number of bidders, so the qualified will stay.
- Protecting the contractors from being awarded a project that they are incapable of performing.
- Speeding the process of the evaluation and awarding the contract.
- Shifting the process form subjectivity to objectivity by bringing a structure to the pre-qualification process.

Chapter 2

DESCRIPTION OF THE CONTRACTOR PRE-QUALIFICATION PROCESS

TENDERS PRE-QUALIFICATION:

This procedure consists of three main stages: pre-qualification of tenders, obtaining tenders, and opening and evaluation of the same. The pre-qualification stage includes the steps from preparation of enquiry documents and invitation to contractors to pre-qualify (see fig1).

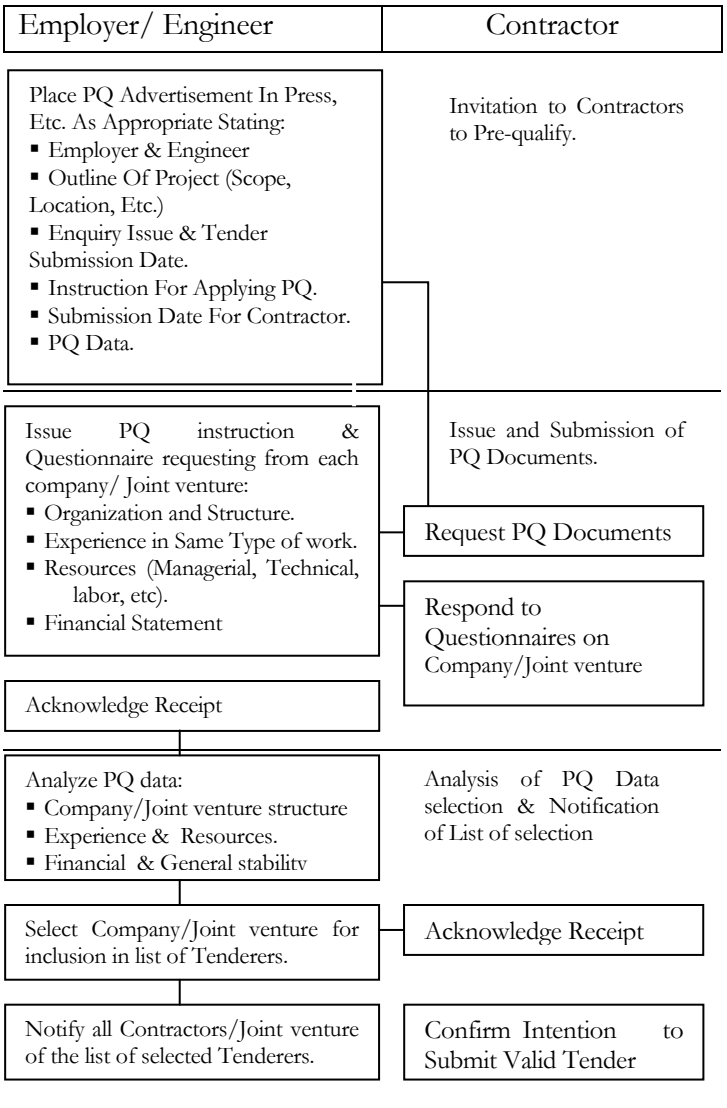

Figure (1): PQ of Tenderers

The first step includes invitation to contractors through advertisement telling the contractors where they can obtain the pre-qualification questionnaire. A typical questionnaire includes the following information:

- Introduction: a brief description of the project.
- Organization: classification and company's organizational chart.
- Financial resources: financial capability of the contractor.
- Physical resources: contractor manpower, equipment, …etc.
- Experience: contractor experience on similar projects.

When the pre-qualification questionnaires are submitted back to the owner, data evaluations will began to eliminate contractors who don't meet the minimum requirements. After short-listing contractors, a notification is sent to each asking them to collect project documents and bid. A general pre-qualification decision-making process is presented in fig2.

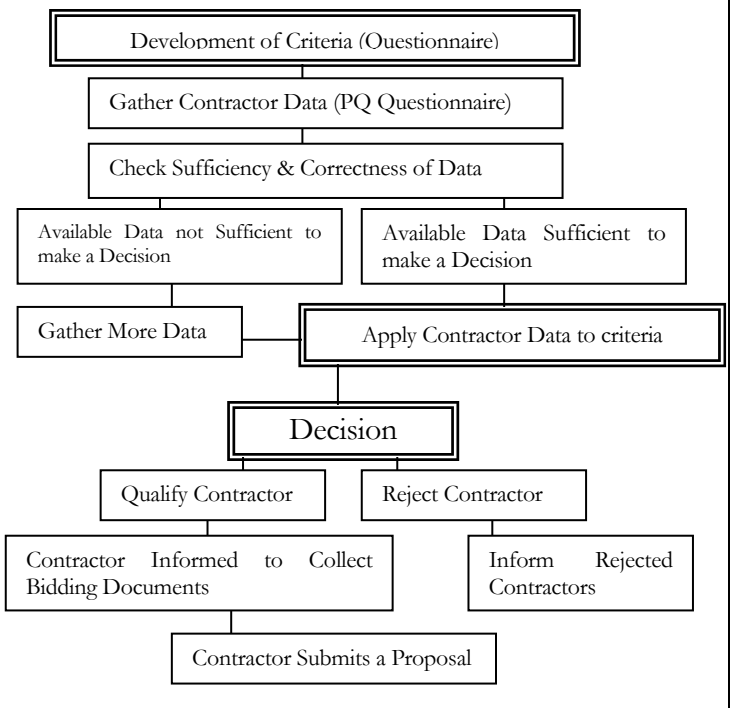

Figure (2): Flow Diagram of Contractor PQ Process.

ELEMENTS OF PER-QUALIFICATION:
This includes three major elements:

1. ***LITTER TO CONTRACTORS (invitation):***

   This letter is sent to each contractor asking him to pre-qualify. A typical letter may include the name of owner, a brief description of the project, and the source of pre-qualification documents.

2. ***PRE-QUALIFICATION FORM:***
   This consists of three parts:

a. Information For The Contractor:

i. Objective and Scope of Work: which includes construction sketches and project description in addition to the scope of work.

ii. General Information:

1. Degree of Eligibility:

This refers to the contractor's capacity to be assigned one or more construction portion of a contract.

2. Formation of Partnership or Joint Venture:

A license proving the validity of this shall be submitted to the owner if he solicits.

3. Bonding Capacity:

Certificates of the bonding company must be attached signifying its willingness to issue bid or performance bonds to the contractor. In addition, the name of the banks with which the contractor is conducting the business must be attached.

4. Official Language:

English is always preferable unless otherwise stated.

5. Supply Materials:

The owner may ask the contractor to procure materials from certain sources desired by him.

6. Questionnaire Submission:

The owner will specify a certain time, date, and location by witch the contractor should submit his per-qualification questionnaire.

7. Beginning and duration of construction:

The owner will insert in the pre-qualification form the recommended date to begin the project and duration.

b. Pre-Qualification Questionnaire:

i. Identification of the Contractor:

Such as the name of the firm, home address, Fax, and phone. Moreover, it tells whether the firm is an individual, partnership, corporation, or joint venture.

ii. Contractor Performance:

A list of current construction contracts performed with details. Sometimes recommendations from the owners of previous projects are required.

iii. Contractor's Equipment:

The amount, type, and condition of the contractor's equipment are important.

iv. Construction Ability:

The ability of the contractor to complete the project should be thoroughly investigated.

v. Completion Ability:

The ability to meet reasonable completion dates successfully should be considered.

vi. Client Relationship:

The ability to work compatibly with the staff of the owner and how cooperative in the field is important.

c. Certification and Waves:

At the end of the pre-qualification form, each contractor will be asked to sign and declare the truth of all information. In addition, the owner may ask the contractor to write a waiver of claim and confidentiality.

3. CONTRACTOR RATING STRATEGIES:

They all try to examine and evaluate the data arrived at the owner's office from the candidate contractors.

a. Dimensional Weighting:

This process is based on the characteristics of the owner. Once the criteria are established, contractors can be rated with respect to these criteria. Contractor's score is calculated as a weighted sum of ratings over all the criteria. The rank order of the scores can then be used for contractors' selection (see table 1). Form these values; cut line can be set to reject all contractors below. A subjective judgment may be used to make a decision.

Contractor Selection Criteria	Weight (%) X	Contractor					
		A		B		C	
		Y	X*Y	Y	X*Y	Y	X*Y
Experience in Completion of Project on Schedule.	60	9	5.4	8	4.8	4	2.4
Present Workload & Capability to Support Project	25	6	1.5	7	1.75	7	1.75
Availability of first-Line Supervisors	15	3	0.45	5	0.75	6	0.9
Total Score	***100***	***6.45***		***7.3***		***5.05***	

Table (1): Results of Dimensional Weighting Strategy for Contractor PQ

b. Two-step Pre-qualification:

Step 1 entails the contractors are qualified or disqualified based on how well they satisfy a number of preliminary screening dimensions. In order for the contractor to be eligible to proceed to the second step in the pre-qualification process, he must meet these criteria. The second step utilizes the dimensional weighting strategy by using more specific criteria to determine the competitiveness of the contractor as described. The application of the two-step pre-qualification allows rapid elimination of unwanted contractors.

CONTRACTOR DATA SOURCES:

This can be divided into two kinds: internal data and external data. The internal data compare the contractor's performance of past projects done for the owner. They are much more reliable than any other source of data. The decision maker may find them through monthly progress reports and discussion with owner's personnel who were in contact with the contractor. On the other hand, the external data are gathered through:

- The questionnaire filled by the contractor.
- Some additional data source such as the banks, subcontractors, and suppliers the contractor deals with.
- Site visits to the propjets currently being completed by the contractor.

Chapter 3

BASIC TECHNIQUE TO PRE-QUALIFY CONSTRUCTION CONTRACTOR:

This technique was divided into two processes: the paired comparison criteria weighting process and the matrix analysis process.

Paired comparison criteria weighting: These criteria differ between projects and owner's need so they must be assigned different weight values according to their impact on the project. This strategy is called "Paired Comparison" (see fig.3). This process can be done through:

I. List all criteria that are considered important.

II. Determine how important each of these to the owner and the project. The importance of one criterion over another can be major (given 3 points), medium (2), minor (1), or none (0).

III. Sum the total raw score of each criterion.

IV. Adjust the raw scores to a scale of 1(low)-10(high).

Project: ----------		**Determining For Weights Evaluation**	
CRITERIA		***RAW SCORE***	***ASSIGNED SCORE***
A	Experience	6	10
B	Equipment	2	3.3
C	Financial Resources	1	1.7
D	Reputation	2	3.3

3- Major Preference.
2- Medium Preference.
1- Minor Preference.
0- No Preference.

	B	**C**	**D**
A	***A-2***	***A-3***	***A/D***
	B	***B/C***	***B-1***
		C	***D-1***
			D

Figure (3): Determining For Weights Evaluation

The evaluation matrix:

This is indicated in firg.4 and can be expressed as Follows:

I. Rank each criterion against each contractor. The scoring system used in the evaluation matrix is to assign 1(Poor)-5(Excellent).

II. Multiply the rank of each with the weight of each criterion.

III. Sum the total score of each contractor and rank them for selection. Contractors having the highest total points are the ones chosen to submit proposals.

Contractor Name: ---------- **Grade:** ---------
Address: ----------

CRITERIA		**Weight**	**5 Exce**	**4 V. G**	**3 Good**	**2 Fair**	**1 Poor**	
A	Experience	10		√				40
B	Equipment	3.3	√					16.5
C	Financial Resources	1.7			√			5.3
D	Reputation	3.3				√		6.6
TOTAL SCORE								***68.4***

Figure (4): The Evaluation Matrix

This technique can't handle a large number of criteria and may trap when determining the preferences of the criteria.

The involvement of quantitative and qualitative data analysis is crucial. The purpose of quantitative analysis is to reveal those questionnaire items that have major influence and those having minor influence on the contractor pre-qualification process. On the other hand, the purpose of qualitative is to test if the means of the questionnaire items provide by the participants are statistically different at assigned level of significance.

MODEL PHILOSOPHY:

This model utilizes a dimensional weighting approach based of multiple-criterion decision-making. In this way, each decision factor (criteria) used for the evaluation and its weight is determined based on the preferences of decision maker.

The following assumptions are associated with this approach:

1. The impact of each criterion can be quantified on a numerical scale 1[unsatisfactory] to 10[excellent].
2. The numerical value can be reasonably obtained from the pre-qualification (PQ) questionnaire made by the decision maker and filled in by the contractor.
3. The addition or deletion of any decision parameters requires no dependency of the model's parameters.

In order to develop PQ model, two types of parameters are need to be determined. They are called Composite Decision Factor (CDF) and Decision Factor (DF). A CDF represents a single construct made up of interrelated DFs (see fig 5).

Once the CDFs and their associated DFs are determined, the decision maker will give each a weight according to its influence on the PQ process.

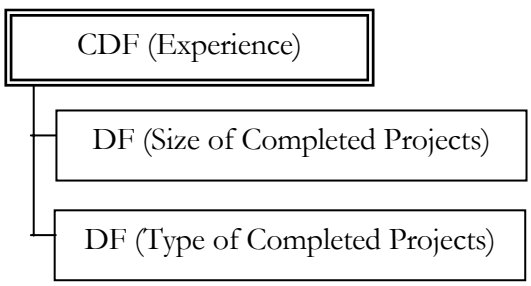

Figure (5): Example of Decision Parameters

THE CALCULATION OF MODEL PARAMETERS:

Calculation of Decision Weights:

This enables to determine which extend each decision factor and sub-factor impacts the PQ decision process using a scale from zero (no impact) to four (very high impact). The responses of each CDF will be translated to weights according the followings steps:

a. Calculate the mean impact for each DF included in each CDF. The

b. Calculate the DF weight to each DF from equation:

$$w_{ij} = \frac{DFMI_{ij}}{\sum_{j=1}^{m_i} DFMI_{ij}} \text{ ---------(Eq.1)}$$

Where: *wij* = the weight of the *DFj* associated with the *CDFi* .

DFMIij = the mean impact of the *DFj* associated with *CDFi*.

c. Calculate the mean impact for the CDF from equation:

$$CDFMI_i = \frac{\sum_{j=1}^{m_i} DFMI_{ij}}{m_i} \text{ -------(Eq.2)}$$

Where: *CDFMIi*= mean value of CDF.

mi = the number of DFs in the CDF.

d. Calculate the weight of the CDF using the equation:

$$w_i = \frac{CDFMI_i}{\sum_{i=1}^{n} CDFMI_i} \text{ ---------(Eq.3)}$$

e. Find the aggregate score of the candidate contractor K using the following equation:

$$AWS_K = \sum_{i=1}^{n} wi \left(\sum_{j=1}^{m_i} \langle wij \rangle \langle R_{ijK} \rangle \right) - - - (Eq.4)$$

Where: AWS_K: aggregate weighted rating for the contractor K.

n = number of CDFs ; m = number of DFs in the CDF.

R_{ijK}: score of the DFj in the CDFi for the contractor K on scale of 1(unsatisfactory) to 10(excellent for specific project). The approach to calculate this value is described in the following paragraph.

The CDFs are listed in levels whereby each CDF is placed at one level. At each level of CDF, three possible decision answers exist.

1. To disqualify the contractor for this CDF and terminate the process (if $R_{ijK}=0$).
2. To disqualify the contractor for this DF and continue for the next DF ($R_{ijK}=0$).
3. To qualify the contractor (R_{ijK} =x where 1<x<10).

Note that the difference between rules 1& 2 is that in rule 1 the decision factor (called critical decision factor) is considered highly important in that if the contractor has failed in this DF, the whole process will terminate and a new contractor will be evaluated. However, in rule 2 if the contactor failed in that DF, then only for that DF will be zero and the system will go to the next DF. This means the concerned DF is not so important to be considered.

DATA COLLECTION:

For this type of data analyses, questionnaires among the contractors are the basis for this PQ model technique. The author of this thesis has selected three main contractors in Bahrain. Questionnaires consisting of 16 CDF and 37 DF had been distributed among them to conduct this study. A sample calculation for this technique is shown in the following Sample Data Calculation (Next Page).

MODEL ADVANTAGES:

- Simple and understandable.
- Provides a systematic approach for all candidate evaluation.
- The calculated aggregate weighted score for each contractor provides a basis for comparison.

SIMPLE DADA CALCULATION:

For this sample calculation, three CDFs with eight (8) CFs were initiated to conduct PQ study for three different contractors. For evaluating Rij_K or scoring for each DF as stated earlier, questionnaire should be addressed with these criteria during information gathering and the evaluation shall be compromised with scoring of questionnaire results.

Contactor A:

CDF(1)	DF	DFMI	Wij	CDFMIi	Wi	Rijk	Wij*Rijk	AWSK1
Financial Stability	Banking Arrangement	2	0.222	3	0.375	3	0.667	1.91667
	Bonding Capacity	4	0.444			4	1.778	
	Financial Statement	3	0.333			8	2.667	
	$\sum_{j=1}^{m} i\ DFMI_{ij}$	9				$\sum_{j=1}^{m} i \langle w_{ij} \rangle \langle R_{ijK} \rangle$	5.111	

CDF(2)	DF	DFMI	Wij	CDFMIi	Wi	Rijk	Wij*Rijk	AWSK2
Experience	Success of Completing Projects	3	0.375	2	0.25	4	1.500	1.09375
	Size of Completing Projects	2	0.250			3	0.750	
	No of Similar Comletdd Projects	2	0.250			6	1.500	
	Types of Completing Projects	1	0.125			5	0.625	
	$\sum_{j=1}^{m} i\ DFMI_{ij}$	8				$\sum_{j=1}^{m} i \langle w_{ij} \rangle \langle R_{ijK} \rangle$	4.375	

CDF(3)	DF	DFMI	Wij	CDFMIi	Wi	Rijk	Wij*Rijk	AWSK3
Current Work load	Current Work load	3	1	3	0.375	7	7	2.625
	$\sum_{j=1}^{m} i\ DFMI_{ij}$	3				$\sum_{j=1}^{m} i \langle w_{ij} \rangle \langle R_{ijK} \rangle$	7	

AWSK (A)Total = AWSK1+AWSK2+AWSK3 = **5.635**

Contactor B:

CDF(1)	DF	DFMI	Wij	CDFMIi	Wi	Rijk	Wij*Rijk	AWSK1
Financial Stability	Banking Arrangement	2	0.222	3	0.375	5	1.111	1.79167
	Bonding Capacity	4	0.444			3	1.333	
	Financial Statement	3	0.333			7	2.333	
	$\sum_{j=1}^{m} i\ DFMI_{ij}$	9				$\sum_{j=1}^{m} i \langle w_{ij} \rangle \langle R_{ijK} \rangle$	4.778	

CDF(2)	DF	DFMI	Wij	CDFMIi	Wi	Rijk	Wij*Rijk	AWSK2
Experience	Success of Completing Projects	3	0.375	2	0.25	3	1.125	1.09375
	Size of Completing Projects	2	0.250			5	1.250	
	No of Similar Comletdd Projects	2	0.250			4	1.000	
	Types of Completing Projects	1	0.125			8	1.000	
	$\sum_{j=1}^{m} i\ DFMI_{ij}$	8				$\sum_{j=1}^{m} i \langle w_{ij} \rangle \langle R_{ijK} \rangle$	4.375	

CDF(3)	DF	DFMI	Wij	CDFMIi	Wi	Rijk	Wij*Rijk	AWSK3
Current Work load	Current Work load	3	1	3	0.375	6	6	2.25
	$\sum_{j=1}^{m} i\ DFMI_{ij}$	3				$\sum_{j=1}^{m} i \langle w_{ij} \rangle \langle R_{ijK} \rangle$	6	

AWSK (B)Total = AWSK1+AWSK2+AWSK3 = **5.135**

Contactor C:

CDF(1)	DF	DFMI	Wij	CDFMIi	Wi	Rijk	Wij*Rijk	AWSK1
Financial Stability	Banking Arrangement	2	0.222	3	0.375	4	0.889	2.4167
	Bonding Capacity	4	0.444			8	3.556	
	Financial Statement	3	0.333			6	2.000	
	$\sum_{j=1}^{m} i \; DFMI_{ij}$	9			$\sum_{j=1}^{m} i \langle w_{ij} \rangle \langle R_{ijK} \rangle$		6.444	

CDF(2)	DF	DFMI	Wij	CDFMIi	Wi	Rijk	Wij*Rijk	AWSK2
Experience	Success of Completing Projects	3	0.375	2	0.25	4	1.500	1.1563
	Size of Completing Projects	2	0.250			6	1.500	
	No of Similar Comletdd Projects	2	0.250			3	0.750	
	Types of Completing Projects	1	0.125			7	0.875	
	$\sum_{j=1}^{m} i \; DFMI_{ij}$	8			$\sum_{j=1}^{m} i \langle w_{ij} \rangle \langle R_{ijK} \rangle$		4.625	

CDF(3)	DF	DFMI	Wij	CDFMIi	Wi	Rijk	Wij*Rijk	AWSK3
Current Work load	Current Work load	3	1	3	0.375	8	8	3
	$\sum_{j=1}^{m} i \; DFMI_{ij}$	3			$\sum_{j=1}^{m} i \langle w_{ij} \rangle \langle R_{ijK} \rangle$		8	

AWSK (C)Total = AWSK1+AWSK2+AWSK3 = **6.573**

From this sample calculation, the three contractors can be ranked based on their AWS_K earned scores. In this case, Contractor A has the highest score followed by Contractor C then contractor B.

CONCLUSION:

Form this research; it is clear that contractors PQ are crucial to avoid poor quality and work delay. The addressing of several mathematical models here is aimed to minimize if not eliminate all aspects of subjectivities that may lead to undesirable results. The owner of the project shall set the criteria required for the project to be conducted and assign weight for each criterion based on how it is important form the owner point of view. After that, questionnaires to be distributed among the bidders for PQ them. Using the models explained above shall help the owner in determine a list containing only the qualified bidders.

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