Identification of Procurement System Selection Criteria in the Construction Industry in Iraq by Using Delphi Method

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Abstract. In this research, Delphi method was adopted for identification of the selection criteria of the procurement system in the construction industry in Iraq. Three rounds of Delphi surveys were conducted. In the first round of Delphi, selection criteria were obtained and then refined in the second round. The third round was used to measure the consensus between experts on the weighting of the utility factors for each procurement system against each selection criterion by using statistically significant consensus. The result from Delphi rounds is fifteen exclusive selection criteria for the selection of the procurement system in Iraq. These criteria will be then used to develop a selection model or method that can be used to assist the client in the selection of the procurement system. The Delphi method provides to be an effective and appropriate research tool in the difficult area of construction procurement and provided interesting results and a useful comparison with the Iraq survey.

Keywords: Delphi Method, Selection Criteria, Procurement System, Consensus.

1. Introduction

Procurement system is the organizational structure adopted by the client for the management of the design and construction of a project [1]. The selection of an appropriate procurement system is an essential factor in every building project and has recently become more difficult with the increasing variety of available options for clients, constructions and consultants. The appropriate choice of a procurement system is vital for success of building project and that making the wrong choice could result in time delays, cost overruns, or quality problems.

One of the major difficulties associated with procurement selection includes no mutually exclusive sets of criteria uniquely and completely determine the appropriate procurement method for a specific project [2], [3] and this generates the need to follow a systemic way for the selection of the criteria for the particular area.

Several studies, such as those identified in Skitmore and Marsden (1988), Bennett and Grice (1990) and Love et al. (1998) have used modified versions of the National Economic Development Office (NEDO) (1985) criteria in an attempt to develop a procurement selection framework [4]. In Cheung et al. studies, selection criteria were conducted first by collecting the criteria from previous studies, where eleven criteria were selected. In the second stage, a pilot study was conducted with five project management experts. The result is eight selection criteria [5], [6]. Luu et al. reformulated previous procurement selection criteria (PSC) into an underlying factor according to the relationships between them [7].

As shown, the major drawbacks of the previous methods for the selection of the criteria are:

- Most of the systems reviewed previous studies and then selected the criteria that were relevant to local context and were not selected from the fact.
- Some of these systems depend on three to five experts to collect or to evaluate the criteria.
- There is a problem of consistency in adopting the criteria.

For this reason, Delphi method was adopted to overcome these shortcomings of the selection criteria methods.

2. Research Method: the Delphi method

2.1. Introduction

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"Delphi method is a survey technique for achieving consensus among isolated anonymous participants with a controlled feedback of opinions'' [8]. This technique is being increasingly used in many complex areas in which a consensus is to be reached. Some of these areas included the development of residential areas, theory and design application, and bridge condition rating and effects of improvements [9]. Moreover, the Delphi method is a highly formalized method of communication that is designed the maximum amount of unbiased information from a panel of experts [10]. Therefore, this method is adopted and used for obtaining a set of selection criteria for the selection of the procurement system.

2.2. Main Characteristics of the Delphi Method:

The Delphi method has seven major characteristics [11], [12] and [13]:

- The sample consists of a "panel" of carefully selected experts representing a broad spectrum of opinion on the topic or issue being examined.
- The panel size is between (15-30) with heterogeneous population and (5-15) for a homogeneous population.
- Participants are usually anonymous.
- The "moderator" (i.e. researcher) constructs a series of structured questionnaires and feedback reports for the panel over the course of the Delphi.
- It is an iterative process often involving three or four iterations or "rounds" of questionnaires and feedback reports.
- It uses statistical methods in the group response to reduce the group pressure for conformity, at the end of the exercise there may still be significant spread in individual opinions. This removes irrelevant communication and ensures that the opinion of every member of the group is represented.
- There is an output typically in form of a research report with the Delphi results.

Fig.1 illustrates in brief the conducting of Delphi method.

2.3. Application of Delphi method:

In this section, the Delphi method will be applied in the construction industry in Iraq.

2.3.1. Format of Delphi rounds:

This method adopted for this study consists of four rounds of Delphi as suggested by Chan et al. study [9]. Chan et al. used these rounds first to generate a list of the selection of criteria and second to derive a consensus on the weighting of the utility factors. In this research, these rounds are modified and used them to identify the selection criteria only. The steps of Delphi method are illustrated in brief in fig.2.

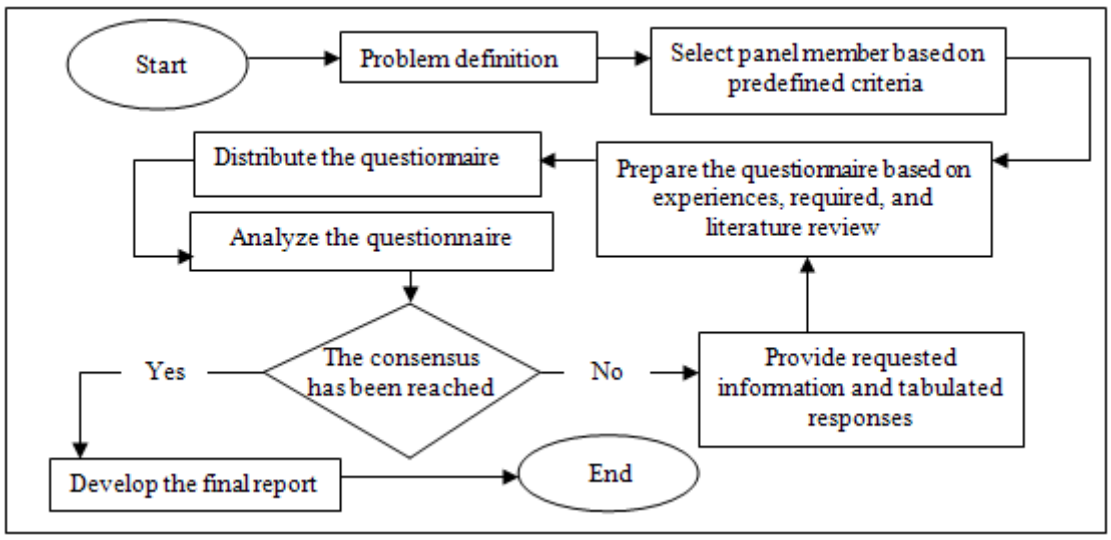

Fig.1. Steps of Delphi method

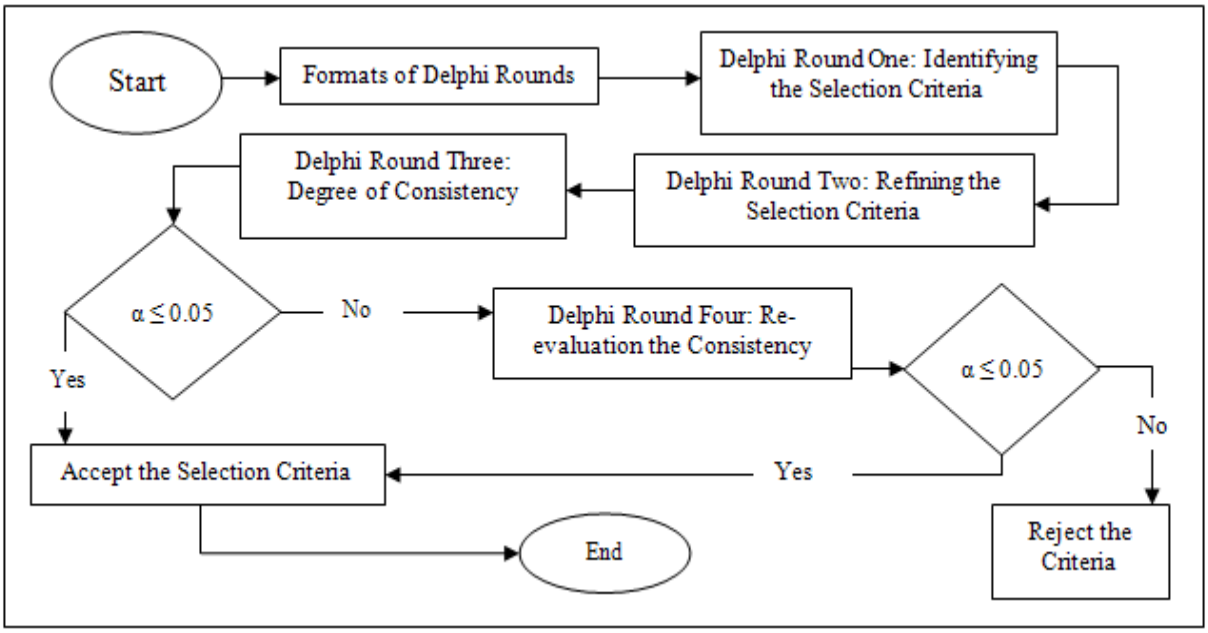

Fig. 2. Application of the Delphi rounds

2.3.2. Selection of the Expert Panel:

The success of Delphi method depends principally on the careful selection of the panel. A group of experts were selected to provide opinions on the suitability of a certain procurement path for a given criterion, based on the following criteria derived from Chan et al. [9]:

- Practitioners to have extensive working experience in the construction industry in Iraq.
- Experts to be currently, recently or directly involved in the management of construction projects in Iraq.
- Experts to have a detailed knowledge of all the procurement options.

Accordingly, a list was prepared of participants from private sector, public sector and academics that would have the required knowledge and/or experience of the project. From the list, major companies involved in construction industry in Iraq are carefully selected. Twenty letters were sent out inviting individuals to take part. The letter explained the purpose of the research; the experts were informed that there would be a number of rounds of questionnaires, and the method of the distribution of the questionnaire would be either by receiving it directly or by an E-mail. Fourteen participants responded and agreed to take part. Three of them came from private sector and seven came from public sector and four were academics.

2.3.3. Conducting Delphi Rounds:

2.3.3.1. Delphi Round One: Identifying the Selection Criteria:

In the first round of Delphi, experts were asked to provide at least five major criteria that they considered to influence the selection of the procurement system in the construction industry in Iraq. If they felt that more than five criteria needed to be listed, they were encouraged to do so. The result of this round is seventeen criteria as shown in Table (1). These criteria were frequencies recorded and prepared to be used in round two.

2.3.3.2.Delphi Round Two: Refining the Selection Criteria:

In the second round questionnaire, the participants were asked to indicate the relevant importance of these seventeen criteria that had been identified in the round one of Delphi survey, using a three-level scale: (very important, important, and not important), also the total frequency distribution of the participants who suggested each criterion in the first round and a percentage of the participants for each criterion is given. The indication of relative importance of each criterion is shown in Table (2). Criteria that attracted only 50% agreement or below in the category of "very important" or of "important" were removed in round three of Delphi survey [9]. As a result, only fifteen criteria were included in round three study.

2.3.3.3.Delphi Round Three; Degree of Consistency:

In round three of Delphi method, experts were asked to enter a utility factor against each procurement system. The utility factor is a factor to indicate the degree of suitability of each procurement system against each criterion [2]. Respondents were asked to enter a score from 10 (representing low suitability) to 110 (representing high suitability) to eliminate the occurrence of zero [9], [11].

TABLE 1: Criteria provided in the first round of Delphi

Criteria	Frequency of criterion by experts	
	No. of Experts	% of experts
1. Quality level	14	100
2.Speed	10	71
3.Responsibility	9	64
4. Flexibility for changes	7	50
5.Price competition	7	50
6.Project size	7	50
7.Technology	6	43
8.Certainty of cost	5	36
9. Risk avoidance	4	29
10.Complexity	3	21
11. Accountability	3	21
12.Familiarity	2	14
13. Time predictability	2	14
14. Client involvement	1	7
15. Availability of procurement system in the local market	1	7
16. Legal issues	1	7
17. Project type	1	7

TABLE 2: Delphi round two results: - frequency distribution and percentage

Criteria	% of experts who stated the criterion as either very important or important	Very Important	Important	Not Important
1. Quality level	100	14	-	-
2.Speed	100	7	7	-
3. Flexibility for changes	100	3	11	-
4.Technology	100	8	6	-
5.Complexity	100	5	9	-
6. Time predictability	100	7	7	-
7.Certainty of cost	93	11	2	1
8.Familiarity	93	5	8	1
9.Responsibility	86	6	6	2
10. Risk avoidance	86	3	9	2
11. Accountability	86	4	8	2
12. Client involvement	86	6	6	2
13. Availability of procurement system in the local market	86	5	7	2
14.Price competition	71	4	6	4
15. Legal issues	71	5	5	4
16.Project size	50	4	3	7
17. Project type	36	1	4	9

An analysis was performed of the fourteen questionnaires received in which the mean of the utility factors for the set of criteria were computed. To ensure that the scores provided by the experts were not simply due to chance, the utility factors were all checked for consistency with the use of a statistical test. To obtain that measure of consistency the Kendall coefficients of concordance (*W*) was calculated for the utility factors using SPSS (Statistical Package for Social Sciences) computer package. The association among the ranking of all the participants is then calculated for each criterion. A concordance coefficient of one indicates that all fourteen participants ranked the procurement path identically and a coefficient of zero means that all fourteen participants ranked the procurement paths differently [11]. If (α) is higher than 0.05, the criteria and their utility factors are transferred to the fourth round and the experts are asked to re-assess the utility factor of each criterion. If α still higher than 0.05, this implies that the experts have a rather different view on the utility factors of these criteria. Therefore, these criteria will be removed.

The results of the analysis showed that α of all criteria are smaller than 0.05 so no need to indicate round four as exhibited in Table (3).

TABLE 3: Concordance coefficient of the utility factors in round three

Selection Criteria	**Average Utility Factors** (Suitability of each criterion against each procurement system)													**Kendall coefficient (*W*)**	**Significant level (α)**
	Separated and co-operative procurement system						Integrated Procurement system				Management oriented procurement system				
	Traditional method	Two stage tendering	Negotiation method	Continuity Contracts	Serial Contracts	Cost reimbursable Contracts	Design and build	Package deals	Turnkey	Develop and construct	Management contracting	Construction management	Design and manage		
1.Quality Level	69.1	74.1	71.8	76.8	76.8	95.9	80.9	75	78.6	82.7	76.8	94.1	87.7	0.259	0.001
2.Speed	60.9	69.5	74.5	82.7	82.7	68.6	94.5	84.5	92.7	77.3	75	91.4	85	0.344	0.000
3. Flexibility for Changes	73.2	67.7	68.2	69.5	73.6	91.8	72.7	67.3	60.5	70	78.2	86.4	78.6	0.236	0.002
4. Technology	51.4	71.8	74.5	69.5	68.2	94.1	78.6	65	71.8	76.4	80.5	88.6	85.9	0.353	0.000
5.Complexity	63.2	79.1	80.9	70	71.8	91.4	96.8	65.9	89.1	81.8	81.4	89.5	86.8	0.325	0.000
6. Time Predictability	90	70.5	67.7	87.7	84.5	50.5	92.3	84.5	88.6	82.3	69.1	80	78.2	0.330	0.000
7.Certainty of Cost	94.1	78.6	78.2	90.9	81.8	43.6	86.4	80.5	82.7	80.5	65.5	68.2	70.9	0.283	0.000
8.Familiarity	101	86.4	84.5	75	73.6	80.5	85	63.2	86.8	64.1	61.4	61.8	65.5	0.403	0.000
9. Responsibility	13.6	65.9	60.9	50	50.5	77.3	96.4	72.7	100	79.1	76.4	70.9	79.5	0.474	0.000
10. Risk Avoidance	84.1	80.9	66.4	70.5	69.5	59.5	74.1	60	72.3	65	62.3	62.3	63.2	0.169	0.034
11. Accountability	74.1	72.7	67.3	70.5	72.3	86.8	96.4	89.5	92.3	79.1	70.9	73.2	69.5	0.171	0.031
12.Client Involvement	72.7	72.3	68.6	59.1	67.7	89.5	59.5	67.7	51.8	68.6	80.5	90	90.9	0.338	0.000
13.Price Competition	93.2	86.4	78.2	80	76.8	54.5	80	76.4	78.6	74.5	74.1	70.5	70.5	0.269	0.000
14. Availability of Procurement system in the Local Market	95.9	86.8	84.1	70.9	74.1	89.1	71.4	70.5	75	65	55.5	51.8	47.7	0.266	0.000
15. Legal Issue	88.2	77.3	77.3	79.6	77.3	69.6	74.6	60.9	70.5	63.2	86.8	85	85	0.168	0.035

3. Conclusions (The Report):

In this study, a Delphi method was adopted to develop selection criteria in the construction industry in Iraq. Three Delphi rounds were conducted in this study. A set of exclusive criteria for the selection of the procurement system was identified following the first two rounds of the Delphi. The last round of the Delphi was to derive a statistically significant consensus on the weighting of the utility factors. The aim of round three and four, if required is to measure the degrees of consistency between experts and to reject the criteria that do not get the level of significant. The result is fifteen criteria which are (*Quality level, Speed, Flexibility for changes, Technology, Complexity, Time predictability, Certainty of cost, Familiarity, Responsibility, Risk avoidance, Accountability, Client involvement, Price competition, Availability of Procurement System in the local Market, Legal issues).*

The results form Delphi method reveal that this method is an appropriate technique for deriving objective opinions.

Despite the usefulness of the Delphi method, there are difficulties in conducting this method such as time consuming; the completions of three rounds of Delphi questionnaires took about two months. It is very

important to keep the whole panel of experts responding to each round of Delphi; any dropout of the panel of experts would be very undesirable for Delphi method.

The goal of the Delphi method is not to produce a single answer as output, but instead to produce a relatively narrow spread of opinions within which the majority of experts concurs.

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List of Abbreviations

Abbreviations	Descriptions
NEDO	National Economic Development Office
PSC	Procurement Selection Criteria
SPSS	Statistical Package for Social Sciences

List of Symbols

Symbols	Descriptions
α	Significance Level
W	Kendall Coefficient of Concordance