EXPLORING THE COST DEVIATIONS BETWEEN DESIGN STAGE COST PLAN AND THE INITIAL CONTRACT SUM

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ABSTRACT

This study is to investigate the reasons for disparity between design stage elemental cost plan and the contract sum as far as related to road projects in Qatar. A number of risk factors responsible for such variations were identified through the literature survey. A two round Delphi method was utilized in complementing responses from expert interviewees, resulting in further dominant factors influencing early cost overrun. The interviews further indicated that risks have both positive and negative impact on the initial budgeted sum responsible for the deviations experienced. Relative importance index method was used for hierarchal assessment of factors. The top 3 most significant factors of cost deviation are change of the mode of procurement after tender calling, red carpet negotiations just before the contract award and increase in markup due to client's pressure to early completion. With this information, Quantity surveyors are more able to accurately forecast the likely contract sum, thus increasing the accuracy of design stage elemental costing. There is no recent empirical evidence of an investigation into the reasons for disparity between design stage elemental cost plan and final tender sum in procuring road projects in Qatar.

Keywords: *contract sum, cost overrun, detail design, risk factors*

1. INTRODUCTION

Cost plans portray the likely financial commitment of the client. Clients are desperate in knowing the changes in the budget as the design progresses. The reliability of tender sum (contract sums once awarded) depends on how accurate the cost projections are (Seeley,1996). However, much efforts are made in the preparation of cost plans as accurate as possible, deviations are inevitable. This makes cost predictions challenging (Johnson et al, 2015). The major reasons for the difference between design stage elemental cost plan and final tender sum are the risk elements that are not easily identifiable. Joshua and Jagboro (2007) suggested that risks are inevitable and indeed expose project activities to economic losses from both foreseeable and unforeseen events. If risk is not managed properly, it becomes detrimental to cost, time and quality targets (Johnson et al, 2015). When cost plans are being prepared, risks are associated mainly with the level of project information available. Odeyinka et al (2010) explained that the smaller the level of information available, the higher the level of uncertainties and hence risks. This view was shared by Zou et al (2007) and Taroun et al (2011). Thus, as project information increases, risks are expected to decrease.

Traditionally, the allocation of contingencies is to address these risks. Contingencies are often calculated as 'across-the-board' percentage on the base estimate, typically derived from intuition, past experience and historical data (Bello & Odusami, 2008). This conventional approach has been criticised (Bello & Odusami, 2008). Effective risk management requires the integration of risk management techniques into the estimation of construction project costs (Farinloye et al,2009). Thus, more analytical and scientific methods have been evolved in construction risk assessment (Baloi & Price, 2003; Bello & Odusami, 2008; Hlaing et al, 2008; Tsai & Yang, 2010; Musa et al,2011), which could improve the estimating accuracy. A plenty of research has been done on how these predictions vary with the actual costs of construction. However, the actual cost can be substantially varied from the planned cost itself (Balwani et al, 2014). Hence, it is important to understand the dominant factors that make this ballpark figure no longer valid at the time the contract is awarded.

1.1.Research Gap

There has been enough attention on the reasons behind cost overrun measured between the initial contract and the final contract sum. However, lesser attention is given to the disparity between design stage elemental cost plan and final tender sum. This study therefore addresses this knowledge gap. The study is undertaken with a view to providing information on the factors responsible for the variation between the cost plan at design stage and the contract sum. As such, the study finds its significance. The context of this study is cost planning in road projects in Qatar.

1.2. Aim & Objectives

This research aim is to examine the reasons for disparity between design stage elemental cost plan and final tender sum. Linked to this, the objectives are:

- To determine risk factors inherent in the preparation of the design stage elemental cost plan; and

- To identify risk factors that are dominant for disparity between the design stage elemental cost plan and final tender sum specific to road projects in Qatar.

2. LITERATURE SURVEY

Cost planning is a systematic application of cost criteria to a building design process to maintain in the first place, a sensible and economic relation between project parameters (cost, time, quality and functionality) and, in the second place, provide overall control of proposed expenditure as circumstances might dictate Seeley (1996). Several contemporary authors including Ashworth (2004), Ashworth and Hogg (2007), Kirkham (2007), Smith and Jaggar (2007) and Ashworth (2008) have expressed that cost planning is not only a pre-tender estimating method but also a control mechanism during the design stage. The need for sound cost planning does not appear to diminish (Smith et al, 2004). Smith et al (2004) suggested that cost planning should be robust enough to adapt in a variety of procurement environments, too.

Odeyinka (2010) asserted that no matter how much care and effort is put into the preparation of a design stage elemental cost plan, deviations observed between it and the final tender sum are usually significant. If risks have been properly identified and priced at the design stage, observed variance between design-stage elemental cost plans (ECPs) and final tender sums (FTS) (initial contract sums) could be reduced (Johnson, et al, 2015). The assessment of these risk elements could assist in determining the final tender sum from cost plans (Johnson 2015). According to Odeyinka (2010), the major reason for this is the risks inherent in both design and construction. Whilst it is recognized during the design phase, the traditional way of dealing with risks is to make a percentage contingency allowance. RICS New Rules of Measurement 1 (NRM 1, 2012) identified contingency provision as a key element that could be incorporated into the elemental cost plan. These contingencies are to provide for risks associated with design development, construction, employer driven changes and other employer restrictive concerns.

Further, the NRM 1 (2012, p. 51) gives the key constituents of an elemental cost plan. The base cost estimate is the total estimated cost of the building works, main contractor's preliminaries and main contractor's profit and overheads. Therefore, the base cost estimate contains no allowances for risk or inflation (that is, the risk-free estimate). Also, allowances for risk and inflation are to be calculated separately and added to the base cost estimate to determine the client's cost limit.

Smith and Jaggar (2007) categorized contingency factors including the risks involved during cost planning stages, especially from outline proposals onwards as: planning contingency (planning restrictions, legal requirements, environmental concerns, statutory constraints, etc.); design contingency (inadequate brief, aesthetics and space concerns, changes in estimating data, incomplete drawings, little or no information about M&E services, etc.); contract contingency (variations encountered during construction); and project contingency (delays, disputes, inflation, fee negotiations, etc.). Further useful contributions relating to risk checklists were made by other researchers including Akintoye and Fitzgerald (2000), Ashworth (2004), Hlaing et al (2008), Odusami and Onukwube (2008), Odeyinka et al (2010) and Greenhalgh and Squires (2011). Combined, they highlighted the relevance of a number of risk factors that are inherent in the preparation of pre-tender cost estimates, namely project scope and quality definition; type and quality of cost data; skill and experience of consultant; proficiency in estimating; historical data from previous similar projects; inadequate tendering period; site investigation information; choice of site; and site location. The lists of typical risks above for each of the categories are not meant to be definitive or exhaustive, but are simply a guide (RICS NRM 1, 2012). In addition, the essence of having an elemental cost plan as a reliable budgetary tool is overcome if these risk elements are not captured and properly evaluated.

Odeyinka et al. (2010) explained that the budgeted cost established by the consultant Quantity Surveyor at the pre-contract stage forms the basis for the assessment of the tender sums submitted by bidders. The successful tender, therefore, becomes the final tender sum for the project. Potts (2008) suggested that most clients work within tight pre-defined budgets which are usually part of a larger overall scheme. If a budget or cost plan is exceeded, the whole scheme may fail. Pre-contract estimating produces the original budget or cost plan and this forecasts the likely expenditure for the client. Odeyinka (2012) submitted that this budget or cost plan should be used positively to make sure that the design stays within the scope of the original scheme. Moreover, the accuracy of design stage cost plans is a major concern for construction clients and practitioners, especially quantity surveyors. Although, several researchers have long expressed their concern about design stage cost estimating inaccuracies by recognizing that the level of accuracy achieved in cost estimating has been less than desirable. Table 1 depicts the outcome of the previous similar researches undertaken to locate reasons for the deviations in predicted costs during design stage. Many factors that affect the accuracy of pre-tender cost estimates are discussed by many researchers and these studies identified the risk factors constituting the reasons for estimating inaccuracies (Table 1).

Table 1: Previous research findings

#	Research	Mean deviation	Variation coefficient	The most dominant factor identified
1	Ashworth and Skitmore (1983)	Significant	-	Client requirement is vague
2	Morrison (1984)	12%	-	Newly added scope

3	Skitmore (1986)	1.29	5.88	
4	Ogunlana and Thorpe (1987)	3.58	5.25	Lack of rationality in making forecasts
5	Tan (1988)	11.5	15	-
6	Ogunlana (1989)	Significant	-	Changing end user requirement
7	Ogunlana (1991)	considerable	-	Price escalation
8	Cheong (1991)	+/- 32%	-	
9	Cheong (1992)	5.1%	6.6%	Scope changes
10	Gunner (1997)	3.47	4.46	Newly added scope
11	Gunner and Skitmore (1999)	10%	-	Scope increase
12	Skitmore and Picken (2000)	3.8%	7.82%	Scope increase
13	Odeyinka and Yusoof (2003)	42.5%		-
14	Akintoye (2000)	15.5%		Unprecedented market vacillations
15	Akintoye and Fitzgerald (2000)	22%		Errors in outline specifications
16	Akintoye (2000)	Considerable		Lack of expertise
17	Enshassi et al (2005)			Lack of detail design
18	Enshassi et al (2007)			Lack of detailed information
19	Aibinu and Pasco (2008),	Significant		Price escalation
20	Odusami and Onukwube (2008)	40%		Scope explosion during tender
21	Onukwube et al (2009)	35%		Poor cost prediction
22	Oladokun et al (2011)	Considerable		Changing end user requirement
23	Jafarzadeh (2012)	-		Changes in tax legislation

24	Enshassi et al (2013)	-	Unprecedented price escalation
25	Johnson et al (2015)	-14% to 16%	Changes in owner's requirements/client's change

3. RESEARCH METHODOLOGY

The choice of the approach for the research depends on the nature of the study area. Amaratunga et al (2002) specified that quantitative approach gives a number of advantages over the qualitative approach such as reliability of the result and high level of data validity. De Langen (2009) highlighted that a qualitative approach is a systematic way of assessing ones' experience and life incidents. This study utilized both qualitative and quantitative mix approach. Delphi technique was used as the data collection technique through a series of questionnaires disseminated among a group of consulting quantity surveyors in two rounds in order to reconfirm their perception. Two rounds are sufficient for collecting data for the researches as a minimum level (Chia-Chien, 2007). At the end of each round, the result is summarized statistically.

There are four main features (Rowe & Wright, 1999) associated with the Delphi techniques (Anonymity, Iteration, Controlled feedback and Statistical aggregation). Anonymity is achieved by giving the questionnaires to the group of experts. Each expert gains the opportunity to express their own opinion privately and without undue social pressure. Iteration means the repetition of giving the questionnaires to the individual experts over several rounds. Experts are given the opportunity to change their opinions freely. This research included two rounds of iteration by allowing the experts to refine their opinions. Therefore, greater consensus, confidence and accuracy could be achieved over rounds as one of the aims of the Delphi technique. Controlled feedback is gained in iteration which is provided statistically using a summary of all responses in terms of mean and relative importance. Statistical average of final iteration is taken as the final outcome of the study after the number of iterations.

4. FINDINGS & DISCUSSION

The experts were selected through a snowball sampling method for applying the Delphi technique because these experts were preferred owing to the fact that project cost planning falls within their areas of concentration in practice. If the experts are homogeneous by background in relation to the subject matters under investigation, the sample size can be ten to fifteen (10-15) (Delbecq, 1975). In this study, though fifteen experts were invited, only ten experts gave consent to participate in the research. Therefore, the sample size is ten. Table 1 gives the respondent's profile.

As viewed by Gibson and Brown (2009) document analysis refers to the process of using documents as a means of social investigation and involves exploring records that individuals, professionals and organisations produce. In this study, the use of document analysis helped justify the theoretical conclusions generated from the review regarding risk identification. Apart from empirical collection, some underlying contextual information was also gained from the interviews. Thus, the interviews helped gain insights into people's experiences in particular project scenarios (Taylor & Bogdan, 1984). Zuo (2010) also suggested that interviews provide detailed understanding emanating from direct observation of people and listening to what they have to say at a particular scene. Hence, general knowledge about cost and risk issues with a focus on the risk factors responsible for the disparity between design stage elemental cost plans and final tender sums in the selected road projects were obtained. There was also an aspect of the interview questions that sought possible solutions to this disparity.

Table 2: Respondent profile

Name	Designation	Experience	Round 1	Round 2
R1	Senior Quantity Surveyor	10 years	Yes	Yes
R2	Project Quantity Surveyor	13 years	Yes	Yes
R3	Commercial management	22 years	Yes	Yes
R4	Quantity Surveyor	10 years	Yes	Yes
R5	Senior Quantity Surveyor	14 years	Yes	Yes
R6	Chief Quantity Surveyor	15 years	Yes	Yes
R7	Contracts administrator	18 years	Yes	Yes
R8	Quantity Surveyor	12 years	Yes	Yes
R9	Quantity Surveyor	10 years	Yes	Yes
R10	Quantity Surveyor	13 years	Yes	Yes

The questionnaire for the first round of the Delphi technique could be either structured or unstructured questions (Chia-Chien, 2007). This study consists of semi structured questions because of sufficient literature findings to continue the study. Further, additional information which are outside from pre-specified limits can be provided by the experts within controlled feedback in iteration (Rowe & Wright, 1999). The round one was allowed to mention new factors if any other than those cited in the questionnaire. Therefore, the group of experts involved in the first round relatively has a free hand to answer the questions, thereby identifying the issues as they consider important. These individual factors were then collated and considered in preparing a more structured questionnaire for the second round in order to identify the agreements and disagreements. The aim of the second round was to improve the suggestions made in the first round.

4.1. Data Analysis

In Delphi technique, data analysis is carried out just after the collection of data in each round. Analysis of a round of the Delphi technique assists the next round (Helmer, 1967). Data collected in Delphi round 1 was analysed to determine the critical reason(s) for cost deviation. According to Chia-Chien (2007), analysis in Delphi technique can be done with a minimum 3 point of Likert scale. First round of the technique was analysed with a 3-point scale and using Mean Weighted Rating (MR). The subsequent round two was analysed with the 5 point Likert scale using Relative Important Index (RII). Hasson, Keeney and Mckenna (2000) specified that mean, median and mode are ideal for the analysis using Delphi technique. Therefore, Mean Weighted Rating (MR) was used for calculating the level of significance using the following formula.

$$\textbf{Mean Weighted Rating} = \frac{\sum (Vi \times Fi)}{n}$$

Where, Vi = rating for each factor, Fi = frequency of responses and n = total number of responses. The factors which had a MR value greater than 2.00 were considered as significant for cost deviation (as the midpoint is 2.00 in three-point scale). Suggestions made in the first round were improved in the second round.

There were 10 factors selected out of the literature survey, a group of 18 factors were selected altogether, with the 8 factors newly added after the opinion survey. These new factors have been given bold in the Table 4. All of these factors were selected for the second round questionnaire from ten factors which had been quoted in the first round. Ten questionnaires were given for the same group of respondents who participated in the round one. This repetition of distributing the questionnaire to the respondents over several rounds is called "iteration" in Delphi technique. Iteration is done because the individuals tend to change their opinions freely where the most accurate answer is anticipated from the respondents. In Delphi second round, a Likert scale with five level was used as follows;

1-Very low 2-Low 3-Medium 4-High 5-Very high.

Relative Important Index (RII*)* can be used for ranking factors in terms of relative significance (Tayalan, Bafail, Abdulaal & Kabli, 2014). The formula applicable is;

$$RII = \frac{\sum (W\,n) \times 100}{A \times N}$$

Where, W= Constant expressing the weighting given to each response, A= The highest weighting, N= Total number in the responses, n= The frequency of response. According to Taylor (2010), analysis will give most reasonable answer for the researches whenever the value of RII is 50% or exceeds 50%. However below mentioned method was followed as selection criteria for being more specific during the selection of the factors.

To identify the marginal mark for RII, the value provided by respondents for a factor is considered as "3". Number 3 was considered because it is bordering value which separates the importance level "Low" to "High". Then RII value will be (3+3+3+3+3+3+3+3+3+3) x 100 / (10 x 5) = 60%. Then the factors which have RII values ≤ 60% were removed from the item list because those factors are deemed to be less important. Meanwhile, the summary of the Delphi rounds including details of data collection and data analysis is illustrated in Table 3.

Table 3: Summary of Delphi rounds

Attribute	Round 1	Round 2
Duration	Three Weeks	Four Weeks
Instrument	Semi-structured Questionnaire 1	Structured Questionnaire 2
Data Collection	Identification of reasons for cost deviation.	Identification of significant reasons for cost deviation
Data Analysis	MWR	RII
Iteration	2 or above 2	60% or above 60%

Ten (10) responses were received in the first round of data collection. Subsequent rounds also had the same response. Therefore, the rate of responsive was 67%. The severity of each reason was required to rank by the respondents. In order to identify the severity level of the reasons for cost deviations, the scale used was 1 – Not severe 2 – Less severe 3 – Very severe. All responses were analysed with the Mean Weighted Rating (MR). Table 4 shows the MR values.

Table 4: MR values of reasons for cost deviation

No:	Reason for cost deviation	MR
1	Single direct award (changing the mode of procurement)	2.75
2	Red carpet negotiations just before the award	2.70
3	Increase in markup due to client's pressure to early completion	2.70
4	Changing supply routes (as a result of embargo)	2.60
5	Last minute scope changes	2.60
6	Unforeseen cost on acquisition and compensation	2.60
7	Changing end user requirement	2.60
8	Newly added scope	2.50
9	Unprecedented market vacillations	2.40
10	Discounts offered by tenderers to stay in the market	2.30
11	Changes in methods statement (technical approaches)	2.30
12	Deletion of price escalation clause just before contract award	2.30
13	Errors in outline specifications	2.20
14	Lack of expertise	2.10
15	Scope explosion during tender	2.10
16	Poor cost prediction	1.80
17	Changes in tax legislation	1.70
18	Lack of rationality in making forecasts	1.60

Accordingly, the highest value of MR (2.70) has acquired the reason of "changing the mode of procurement". Both the red carpet negotiations just before the award and the increase in markup due to client's pressure to early completion take the second and third positions in the hierarchy. The reasons which acquired MR values below natural point (2.00) were not considered in the Delphi round two, as mentioned. Therefore, poor cost prediction, changes in tax legislation and lack of rationality in making forecasts are set aside. There were 8 newly added reasons in the Dephi round one. Those new reasons have been considered in the Delphi second round. As such, fifteen reasons which were identified from the first round for cost deviation have been reconsidered once again in terms of relative importance. Table 5 represents the RII values of the analysis of data.

Table 5: RII values of reasons for cost deviation

No:	Reason	RII%
1	Single direct award (changing the mode of procurement)	94.00
2	Red carpet negotiations just before the award	88.00
3	Increase in markup due to client's pressure to early completion	84.00
4	Changing supply routes (as a result of embargo)	84.00
5	Last minute scope changes	81.11
6	Unforeseen cost on acquisition and compensation	80.00
7	Changing end user requirement	76.00
8	Newly added scope	58.00
9	Unprecedented market vacillations	57.78
10	Discounts offered by tenderers to stay in the market	54.00

Highest RII (94.00%) is recorded once again in changing the mode of procurement. Respondents ranked it as the highest impacted factor. The factors which gained IRR values ≤ 60% were removed from the list because of less impact on the cost deviation. As such, only seven reasons were highlighted in the final round.

The results further showed that 'discounts offered by tenderers' to stay in the market coupled with the reason of 'red carpet negotiations' that lead to last minute adjustments in the markup would make a negative impact on the budget sum reflected in the cost plan during the design stage. It is noteworthy that drawings are important for communicating the designers' intentions regarding the structure conceived by the project owner. Therefore, project implementation strategies must include procedures for collecting information on project performance that is vital for project planning and control. This explains why incomplete or inadequate design information has partially caused the variance recorded on the budgetary performance at the pre-contract phase of the project.

5. CONCLUSION

Extant literature, interviews and project data have indicated that risks have an impact, first on the preparation of design stage elemental cost plan and, second, on the deviations between elemental cost plans and final tender sums. The assessment of these risk elements could assist in determining the final tender sum from cost plans. The study suggests that the essence of having an elemental cost plan as a reliable budgetary tool is secured if the risk elements are properly evaluated while preparing the design stage elemental cost plan. With this information, Quantity Surveyors are able to accurately forecast the final tender sum from the cost plans through proper risk identification and analysis. It will increase estimating accuracy. This study provides further insight into the relationship between construction costs and various risk variables in terms of the benefits to researchers and experts in the broader global construction community.

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