RISK-CONTINGENCY FUND IN THE DESIGN STAGE ELEMENTAL COST PLANNING FUNCTION: A THEORETICAL EXPLORATION

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ABSTRACT

Effectiveness of contingency fund management can strongly influence project success as contingency is proportional to the risk present in a project. However, the traditional allocation of a contingency fund in construction projects using lump sum or percentage addition method to cover risks in elemental cost plans and tenders has been challenged and criticized leading to the evolution of analytical and scientific methods. Therefore, the purpose of this study is to signify design stage elemental cost planning as a function of risk-contingency fund. The work presented in this paper is a literature-based theoretical exploration, and a preliminary stage of an on-going doctoral research on the budgetary reliability of design stage elemental cost plan. As a first step, a detailed review of related literature was made to establish the risks inherent in preparing the design stage elemental cost plan. Secondly, various contingency-fund estimation methods available for application in construction practice were identified by demonstrating the theoretical context. The insights gained from the foregoing steps then helped in devising theoretical concepts for securing elemental cost plan as a reliable budgetary tool for construction projects through risk-contingency analysis that guarantees cost certainty.

Keywords: Budgetary reliability, construction projects, elemental cost plan, project success, risk-contingency fund

INTRODUCTION

The construction industry, perhaps more than most, is plagued by risk. The industry has traditionally been a major user of formal project risk

management practices (Bryde and Volm 2009) and generic professional guidelines relating to the management of project risk have been specifically extended to construction projects (PMI, 2007; Bryde and Volm 2009). Despite the use of such practices and the existence of such guidelines, project risk in construction environments is often dealt with inadequately, being a contributory factor to the instances of poor performance of construction projects (Jin et al., 2007; Bryde and Volm 2009). Hence, whenever a construction project is embarked upon, there are some risk elements inherent in it such as design risk, price risk, physical risk, environmental risk, logistics risk, financial risk, legal risk, political risk, contractual risk, construction risk, and operational risk among others. These risks must be assessed and accounted for in tenders. Otherwise, a construction enterprise may suffer a tremendous loss and eventually fail (Laryea and Hughes 2006; Odeyinka et al., 2006; Farinloye et al., 2009; Onukwube et al., 2009).

In a similar vein, the traditional allocation of contingency in construction projects using lump sum or percentage addition method to cover risks in cost plans and tenders has been challenged and criticized leading to the evolution of analytical and scientific methods. A contingency sum of NZ$192 million was added as a lump sum to the base estimate submitted as the expected or most likely cost for the Christchurch infrastructure rebuild. Contingencies are often calculated as an across-the-board percentage addition or lump sum on the base estimate typically derived from intuition, past experience and historical data (Bello and Odusami 2008; Christchurch City Council 2011). This is an unscientific approach and a reason why so many projects are completed over budget. Conversely, the cost experts do not show any sign of improving their approach to contingency estimation and management as they are stuck to the conventional methods of lump sum and percentage addition to project base estimate.

The overall aim of this study is to signify the design stage elemental cost planning as a function of risk-contingency fund, with a view to providing a review of the risk elements inherent in preparing the design stage elemental cost plan, and identifying various contingency-fund estimation methods available for application in construction practice. This paper is intended as a preliminary literature review, prior to full research project aimed at developing a predictive model that will assist construction industry practitioners to have a better and reliable prediction of a final tender sum of building project from the cost plan.

RISK AND CONTINGENCY IN CONSTRUCTION

Risk is present in all construction projects; this is reinforced by Latham 1994 cited in (Larkin et al., 2012). He stated that no construction project is risk free; risk can be managed, minimized, shared, transferred, or accepted, it cannot be ignored. It is the general consensus that when risks occur on construction projects, it imposes detrimental effects on the main project objectives of cost, time and quality (Burtonshaw-Gunn 2009; Larkin, Odeyinka et al. 2012).

According to (APM 2006) risk is an uncertain event or a set of circumstances which its occurrence will have an impact on the achievement of one or more project objectives. These views consider the fact that the effect of risk on project objectives could be either positive or negative. Therefore, in order to embrace the common practice usage of the word risk, this research embraces the view that the benefits of positive impacts of risk on project objectives will be achieved by minimising risk occurrence and its detrimental impacts.

Contingencies are crucial to achieving project objectives; they are therefore defined as estimated funds included in development budgets to provide managers with flexibility required to address risks and uncertainties that threaten achievement of project objectives (Diekmann et al, 1988 cited in (Bello and Odusami 2009). (Tseng et al., 2009) defined and explained this further, in the context of owner's perspective, as the budget which is made available to cope with risks and uncertainties that would incur schedule and cost overrun. Thus, this can be interpreted as the amount of money that must be added to the base budget to account for the work that is difficult or impossible to identify at an early stage of the project life cycle.

A key component of a project cost plan is the contingency fund; hence an accurate design cost estimate is an important ingredient for successful project delivery. According to (Musa et al., 2011) the accuracy of design stage cost estimate is measured by the magnitude of deviation between the design stage cost estimate of a project and its actual cost or final tender sum. He further noted that if an appropriate risk-contingency reserve is allowed, it addresses most of the risks associated with a project. Hence, the relative percentage variance between the design cost estimate and the final tender sum or actual project cost is expected to be less when a contingency is included in the base estimate than when it is not. Based on their findings, it was concluded that a project's budgeted cost or final tender sum exceeds its initial estimate by an average value of 5.07% where contingency is applied, and by an average value of 9.52% where no contingency is applied. This further indicates that there is a need for a risk-contingency allowance to ensure an accurate project cost estimate and is employed to cover the risks present in a construction

project in order to avoid project objectives in terms of cost, time and quality targets being threatened.

ELEMENTAL COST PLANNING AND ITS INHERENT RISK

According to (Seeley 1996) cost planning is a systematic application of cost criteria to the design process so as to maintain, in the first place, a sensible and economic relations between cost, quality and appearance, and in the second place, such overall control of proposed expenditure as circumstances might dictate. Hence, it envisages the preparation of a cost plan and the carrying out of cost checks. Dent (1978) cited in (Adafin 2000) also defined cost planning as a system for monitoring cost at the design stage such that (a) tender does not exceed preliminary estimate, and (b) the costs are developed in such a way as to give the client best value for his money. In view of the above expression, cost planning is simply a term which is used to describe any system of bringing cost advice to bear upon design process. However, it is a known fact that no matter how much care and effort is put into the preparation of design stage elemental cost plan; deviations are usually observed between the elemental cost plan and the final tender sum. The major reason for this is risk which is inherent in both design and construction. Whilst it is recognized that the risk factors exist, the traditional way of dealing with them is to make a percentage allowance in form of contingency fund.

As documented in (RICS NRM 1, 2012) the following elements are incorporated into an elemental cost plan as contingency provision to provide for risks associated with design development, construction, employer driven changes, and other employer restrictive concerns:

- Design development risks (changes in estimating data, planning restrictions, legal requirements, covenants, environmental concerns, pressure groups, statutory requirements, procurement methodology, and delays in tendering).
- Construction risks (site conditions, ground conditions, existing services, and delays by statutory undertakers).
- Employer change risks (changes in brief, changes in scope of work, changes in quality of work, and changes in time).
- Employer other risks (early handover, postponement, acceleration, funds availability, liquidated damages etcetera.

Furthermore, RICS NRM 1 (2012 : 51) indicates the key constituents of an elemental cost plan as opined in (RICS NRM 1, 2012) which further illustrated the base cost estimate as 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 for the

building project concerned. At this point, it becomes apparent that the constituents of the risk estimates (11a-d) established in RICS NRM 1 (2012 : 51) compare favourably with the risk elements covered with the contingency factors stated in Figure 1.

In comparison with the foregoing submission, (Smith and Jagger 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 etcetera).
- Design contingency (inadequate brief, aesthetics and space concerns, changes in estimating data, incomplete drawings, little or no information about M&E services etcetera).
- Contract contingency (variations encountered during construction).
- Project contingency (delays, disputes, inflation, fee negotiations etcetera).

As reported in (Smith and Jagger 2007) Figure 1 summarises the activities taking place at the outline proposals stage of project development leading to the preparation of outline cost plan within the cost planning and control principles.

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┌─────────────────────────────────┐
│      Sources of cost information │
│    •  BCIS cost database         │
│    •  Internal cost data         │
│    •  Published cost guides      │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│      Basis of cost targets       │
│  Cost allocations of similar buildings │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│      Project characteristics     │
│  Cost allocations studied in relation to: │
│    •  Building type              │
│    •  Design and construction    │
│    •  Market conditions, etc.    │
│    •  Adjusted as necessary      │
└─────────────────────────────────┘
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Budget
Client's cost limit confirmed and broad cost allocation presented

Cost plan
Realistic estimate confirmed and broad cost allocation presented

Output
An outline cost plan prepared with a frame of reference (cost limit) and method of checking established (group and some element) cost targets

Plus allowances
Add on allowances for:
- Planning contingency
- Design contingency
- Contract contingency
- Project contingency
- Escalation to tender
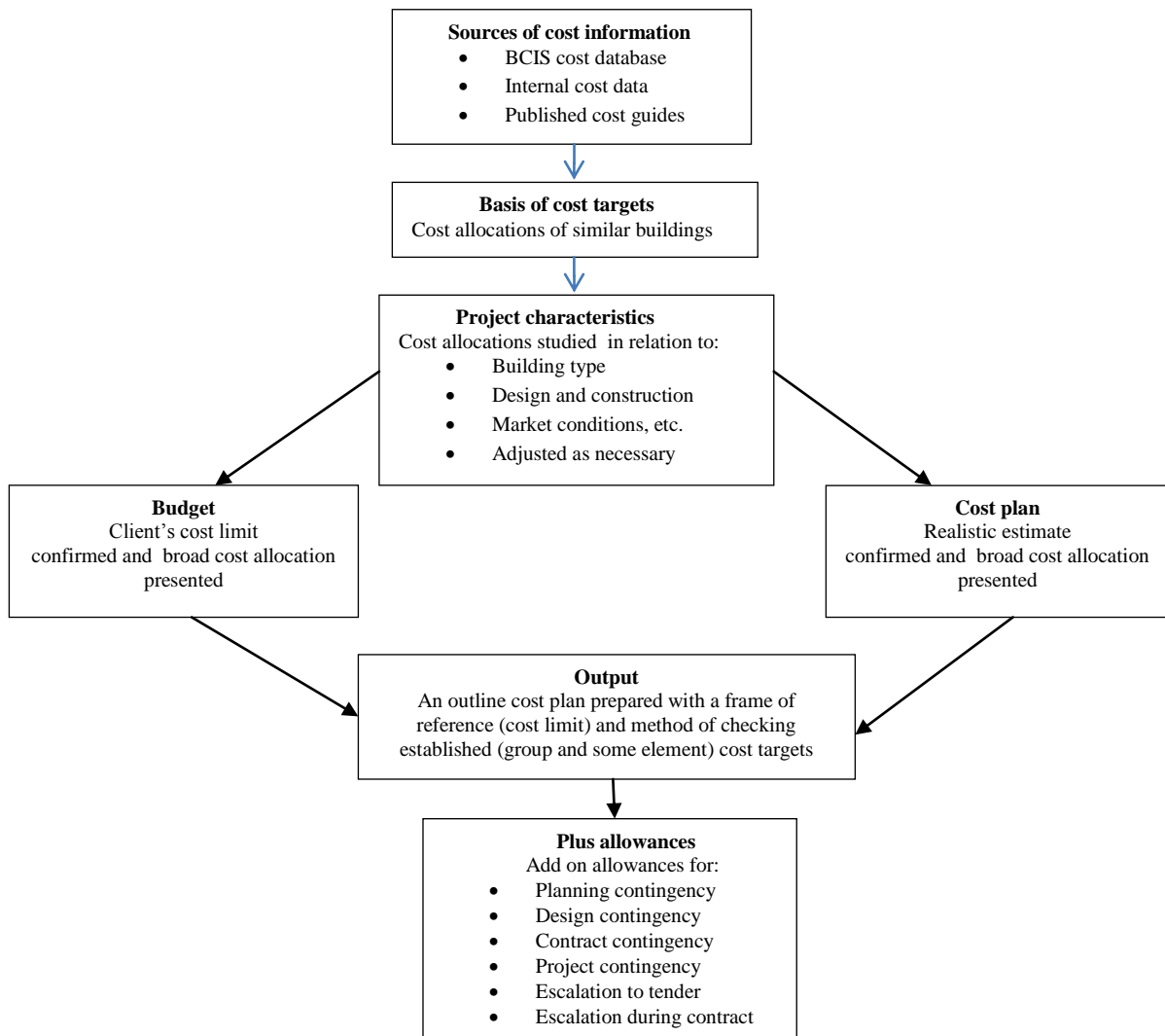- Escalation during contract

Figure 1: Summary of Outline Proposals Stage for Outline Cost Planning (Source: Smith and Jagger , 2007)

From the foregoing analysis, it is concluded that cost planning provides cost data which assist the Architect in making design decisions with full recognition of the RIBA plan of work or project development process, and it incorporates contingency provision to address the risks involved in construction projects as preferably stipulated as a standard in the RICS new rules of measurement. 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 defeated if these risk estimates are not included and properly evaluated. Hence, project objectives regarding cost, time and quality targets are threatened.

CONTINGENCY-FUND ESTIMATION METHODS

Contingency fund is calculated in various ways depending on the organization and level of project sophistication. Some of the methods used according to Hogg (2003) cited in (Musa et al., 2011) are (i) advice from the Architect, (ii) addition of standard percentage of estimated cost, based on previous experience on similar projects, (iii) addition of a sum reflecting intuitive perception of risk, and (iv) addition of a sum based on formal risk analysis. (Picken and Mak 2001) maintained that the practice of presenting project cost plan estimate as a deterministic figure comprising a base estimate and the addition of a single contingency amount (% addition or lump sum) has been adopted in the construction industry for a long time for budgeting purposes. Therefore, the usual practice is having this contingency amount as a single lump sum with no attempt to identify, describe, and value various categories and possible areas of uncertainty and risk. Often, the contingency fund allowed amounts to an educated guess at best.

Besides the conventional lump sum allowance and percentage addition methods, researchers have also developed scientific and statistical methods of contingency-fund estimating and management, but (Bello and Odusami 2008) concluded that most cost experts and practitioners in the construction industry are yet to explore the benefits of these methods as they are still glued to the conventional methods of lump sum and percentage addition to project base estimate. Following Bello and Odusami's (2008) work which reported various contingency-fund estimation methods such as *(i) Lump Sum Amount Allowance, (ii) Traditional Percentage Addition, (iii) Cost Item Allocation, (iv) Probabilistic Itemized Allocation, (v) Programme Evaluation Review and Technique (PERT), (vi) PERT with modified variance, and (vii) Monte Carlo Simulation;* yet some of them are regarded as being deterministic while others are probabilistic accomplished by either expert opinion or statistical methods.

In addition, as documented in Bello and Odusami (2008); Mak et al., (1998, 2000) used a risk analysis methodology to determine construction project contingencies called *Estimating Using Risk Analysis (ERA).* The multiple estimating using risk analysis (MERA) has been documented in Treasury HM (1993) as used by a government agency in the United Kingdom. Hong Kong Government introduced *ERA* in all public works project by identifying and costing risk events associated with a project (Mak and Picken, 2000). Sonmez *et al.* (2007) and Singh *et al.,* (2007) also analysed risk factors affecting contingency decisions.

Table1: Relationship between Risk Allowance and Risk Category in ERA

Type of Risk	Average Risk Allowance	Maximum Risk Allowance
Fixed Risk	Probability x Maximum Cost	Maximum Cost
Variable Risk	Estimated Separately	Estimated Separately
Assumption	50% chance of being exceeded	10% chance of being exceeded.

(Source: Mak and Picken, 2000: 132)

Having identified all risk events and calculated their average and maximum risk allowances, the summation of the average risk allowance of all events will become the contingency of the project concerned (Mak and Picken, 2000). Meanwhile, other methods and applications include the use of fuzzy set theory reported in Moselhi (1993, 1997) and the usefulness of neural network approach to risk assessment and allocation developed by Chen and Hartman, (2000) with the use of Artificial Neural Network.

RESEARCH METHODS

This study is a theoretical research based on literature review with a view to examining elemental cost planning as a function of risk-contingency fund by demonstrating the theoretical context. In addition, the literature sources were accessed through databases which provided numerous academic journals and conference papers. Also, some textbooks found to be useful to the research process were referenced. A comprehensive literature survey was carried out towards securing elemental cost plan as a reliable budgetary tool for construction projects through risk-contingency analysis that guarantees cost certainty.

CONCLUSIONS AND RECOMMENDATIONS

From a detailed review of related literature, it can be concluded that the RICS NRM 1 2012 has established a standard comprising the key constituents of an elemental cost plan. In other words, it incorporates risk estimates based on design development risks, construction risks, employer change risks, and employer other risks which are inherent in the preparation of design stage elemental cost plan. The lists of typical risks are not meant to be definitive or exhaustive but are simply a guide. This conclusion suggested that the essence of having an elemental cost plan as a reliable budgetary tool for construction projects is defeated if these risk estimates are not included and properly evaluated. Hence, project objectives regarding cost, time, and quality targets are threatened. Moreover, the New Zealand Institute of Quantity Surveyors is equally tasked to produce such a practice standard for use in quantity surveying practice in New Zealand.

The second conclusion from this preliminary study is that there is a lack of application of risk analysis in the determination of contingency fund in professional practice. The study identified various methods used in the

determination of contingency fund as an area that needs improvement. The conventional allocation of a lump sum amount and percentage addition to project base estimate was found to be the methods used by quantity surveyors in estimating contingency fund on construction contracts despite the awareness of the scientific methods by a good number of them. Thus, it is essential that quantity surveyors use a quantitative risk analysis technique in their contingency estimation.

The government establishment in New Zealand can also develop a scientific method of estimating contingency fund that can be used as a benchmark for effective performance of construction contingency; this is the practice in United Kingdom and Hong Kong. Researchers and professional bodies like the New Zealand Institute of Quantity Surveyors can take up the challenge of encouraging the use of scientific methods and developing predictive models that are reliable in forecasting construction contingency.

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