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PEER REVIEW PROCESS

The organizers of this conference undertook that in order to ensure highest quality in these proceedings, authors' submission have been subjected to a rigorous double blinded peer review process which involved at least two renowned and knowledgeable experts in the field.

The first stage of the reviews involved the abstracts. A total of 183 abstracts were received for the conference. Each of these was sent to at least two anonymous reviewers. Thereafter, the authors of accepted abstracts were provided with the reviewer comments and were required to submit the full papers, after incorporating all suggested amendments indicated in the reviewed abstract.

Submitted full papers were again subjected to peer reviews by at least two reviewers. The review comments were then sent to the authors of accepted papers with the request that they should address all of the issues raised by the reviewers. They were also required to provide evidence of how they addressed each of the areas of concern. Authors whose papers were rejected were equally provided with reviewer's comments so that they could identify the deficiencies therein. During this peer review process, it was ensured that technical and scientific committee members, editors and organizers were not involved with the review of any paper they authored or co-authored.

At this stage, papers of authors who have demonstrated sufficient evidence that all reviewers' comments had been addressed were accepted into the proceeding. Out of the 104 papers that were received, 78 were finally accepted for inclusion in this conference and proceedings.

AN EXPLORATION OF THEORETICAL CONCEPTS AND METHODS FOR ASSESSING RISK IMPACTS ON THE VARIABILITY BETWEEN DESIGN STAGE ELEMENTAL COST PLAN AND TENDER SUM

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Abstract
Reliable prediction of final tender sums of building projects from the cost plan has posed challenges for construction industry practitioners in New Zealand, especially Quantity Surveyors. No matter how much care and effort is put into the preparation of design stage elemental cost plans, significant deviations are usually observed between these cost plans and the final tender sum. The major reason for this deviation is the risk inherent in both design and construction. This study is a literature-based theoretical exploration and part of an on-going doctoral research aimed at assessing the impacts of risk on the variability between design stage elemental cost plan and final tender sum. This paper first provides a review of the risk elements inherent in preparing the design stage elemental cost plan by demonstrating the theoretical context. Also, it develops a methodology for assessing risk impacts on the variability between the design stage elemental cost plan and final tender sum. The insights gained from the foregoing steps then helped in devising theoretical concepts for securing the design stage elemental cost plan as a reliable budgetary tool that guarantees cost certainty for building projects, and also a methodological framework for assessing the variability between the design stage elemental cost plan and final tender sum.

Keywords: *Elemental cost plan, exploration, final tender sum, risk, variability*

INTRODUCTION

The reliability of tender sums depends on the accurate projections of baseline cost plans developed at the design development stage. However no matter how much care and effort is put into the preparation of design stage elemental cost plans, significant deviations are usually observed between these cost plans and the final tender sum. This makes accurate predictions challenging for construction practitioners. The major attributable factors for the variability between design stage elemental cost plan and final tender sum are risk elements that are inherent in construction project developments. Joshua and Jagboro (2007) suggested that risk is inevitable and exposes project activities to economic losses from foreseen and unforeseen events. If risk is not managed properly, it becomes a threat to project objectives and consequently detrimental to cost, time and quality targets. During the design development stage when cost plans are being prepared, risks are associated with the level of project information available. Odeyinka *et al.* (2010) explained that the smaller the level of information available at the early stages of a construction project, the higher is the level of risks and uncertainties. This view was shared by Taroun *et al.* (2011) and Zou *et al.* (2007). Thus, as project information increases, risk is expected to decrease.

Traditionally, risks in cost plans and tender sums are covered through the allocation of contingencies in construction projects. Bello and Odusami (2008) have indicated that 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. For example, the Christchurch City Council [CCC] (2011) explained that a contingency sum of NZ$192 million was added as a lump sum to the base estimates submitted as the expected or most likely cost for the Christchurch (a New Zealand city) infrastructure rebuild. This conventional approach has been criticized and is a reason why so many projects are completed over budget (Bello & Odusami, 2008). Effective risk management requires the integration of risk management techniques into the estimation of construction projects' cost other than application of common sense and instinct in order to curb cost and time overrun (Farinloye *et al.*, 2009). More analytical and scientific methods have evolved in construction risk assessment.

Many researchers have attempted to model risk in construction projects using various methodologies such as regression analyses and artificial neural network based on the United Kingdom, Australian, Asian and African construction industries (Aibinu *et al.*, 2011; Aibinu & Pasco, 2008; Larkin *et al.*, 2012; Lowe *et al.*, 2006; Ng *et al.*, 2004; Odeyinka, 2007; Odeyinka *et al.*, 2012; Odeyinka *et al.*, 2006; Sonmez, 2004) . However, no attempt has been made by researchers to develop a model that could assist the construction industry practitioners in New Zealand to have a better and reliable prediction of the final tender sum from cost plan. Hence, there is a gap in research regarding risk impacting the observable variability between design stage elemental cost plan and final tender sum with special focus on New Zealand construction environment. As such, knowledge in this area is fragmentary and this is the rationale for this study. Moreover, the specific environment and scarcity of mature research on risk and construction cost in New Zealand require systematic guideline frameworks and in-depth research works to be in place to facilitate its risk management and cost planning 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.

LITERATURE REVIEW

Risk and construction cost

Risks are present in all construction projects but can be managed, minimized, shared, transferred, or accepted, but cannot be ignored (Larkin *et al.*, 2012). The general consensus in literature is that when risks occur on construction projects, they impose detrimental effects on the main project objectives of cost, time and quality (Burtonshaw-Gunn, 2009; Larkin *et al.*, 2012). However, Odeyinka *et al.* (2010) argued that this submission does not consider the possibility of a positive outcome hence they viewed risk as an event which would have either a positive or negative effect on the achievement of project objectives upon its occurrence. According to the APM (2006), risk is an uncertain event or a set of circumstances the occurrence of which 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.

Odeyinka *et al.* (2010) explained that the budgeted cost established at the pre-contract stage forms the basis of the final tender sum and this is the amount arrived at for the entire 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 *et al.* (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, from a pre-tender view, it can be justifiably concluded that elemental cost plan anticipates and predicts final tender sum. Thus, budgetary reliability or performance depends on the degree of variability between the cost plan prepared by the quantity surveyor and tender sums submitted by the contracting firms. Similarly, it is concluded further that the observable deviation between the design stage elemental cost plan and final tender sum is due to the risk factors which are not only hard to predict but also difficult to manage. Thus, many budget overruns are due to circumstances observed as risk factors and an important issue is the ability to predict such factors and the impact they have on the project (Odeyinka et al., 2010). The thrust of this research is the variability between the design stage elemental cost plan and final tender sum. Also, the conjecture of the study is that risk is responsible for the observed variability.

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 relationship 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. Early study by Dent (1978) 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 expressions and within the context of the current study, cost planning is simply a term which is used to describe any system of bringing cost advice to bear upon a 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; significant 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.

RICS New Rules of Measurement 1 [RICS NRM 1] (2012) identified key elements that could be incorporated into an elemental cost plan as contingency provision. These contingencies are 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. This illustrates 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).

Similar to 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.

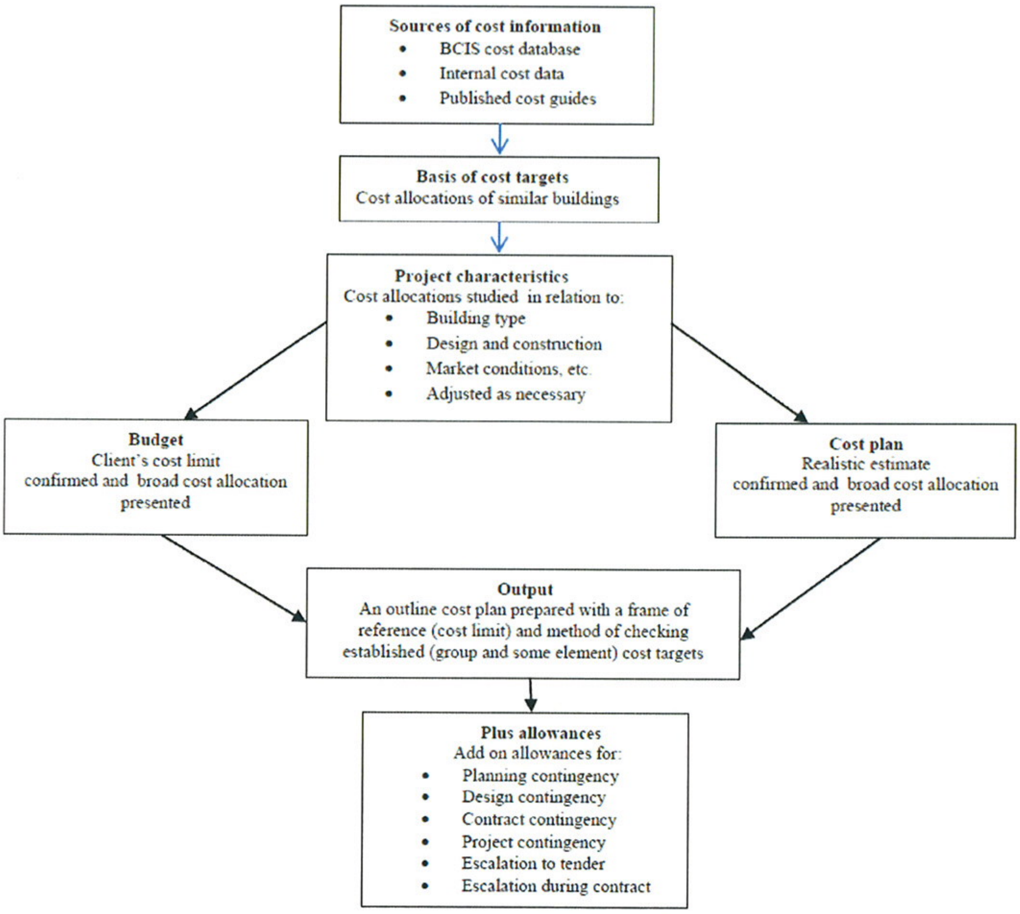

Figure 1: Summary of Outline Proposals Stage for Outline Cost Planning
Source: Smith and Jagger (2007)

From the foregoing analysis, it is concluded that cost planning provides cost data which assists the Architect in making design decisions with full recognition of the plan of work or project development process. The cost plan incorporates contingency provision to address the risks involved in construction projects as stipulated preferably 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 become threatened.

Risk estimate and contingency management

Risk estimates in elemental cost plans are produced to identify the minimum likely, most likely, and maximum likely total costs for a project. The risk items to be considered are usually those which fall within the framework of the construction cost estimate or cost plan. In addition, it is also possible to estimate likely totals for the risks related to the project as a whole thereby giving the client a truer perspective of the total risk he bears on a project. In this context, Fidgen (1999) maintained that risk estimate is prepared to specifically identify the likely level of contingency fund required for a project. Also, being a schedule of all the identified risks, it is used as a management tool to aid control of the contingency expenditure. Moreover, contingency-fund management according to Mukhtar (2008) is seen as the process of planning, allocating and controlling contingency fund towards the achievement of pre-determined project objectives. As explained by Mukhtar (2008) contingency-fund is a special kind of provisional sum, and *Clause 13 of Joint Contract Tribunal 1980 form* provides that "Architect shall issue instructions with regard to the expenditure of provisional sum included in the contract bill". Hence, contingency-fund being a special kind of provisional sum is only expended as directed by the Architect. As a result of this, the quantity surveyor is asked to estimate the amount required for the Architect or Project Manager to approve depending on the procurement system and contractual arrangement.

PROPOSED RESEARCH METHODS

Figure 2 shows the proposed research methods. Following a detailed review of related literature, a two-stage approach will be adopted for data collection. In the first place, a New Zealand-wide online questionnaire survey will be administered to industry practitioners for the collection of primary data needed for the research. The online questionnaire will seek to gather information on recently completed or on-going traditionally procured building projects. The purpose of the questionnaire is to gather information specifically on the risk factors which are inherent in preparing design stage elemental cost plan, coupled with the risk factors which are responsible for the variability between design stage elemental cost plan and final tender sum. There will also be a set of identified risk factors generated from construction management and economics literature which impact on the variability between the design stage elemental cost plan and final tender sum.

The data for the research will be sourced from professionals who have first-hand experience on recently completed or on-going traditionally procured building projects with regards to the extent and impact of occurrence of the identified risk elements on such projects. Respondents will be asked to score on a Likert-type response scale of 0 – 5, the identified risk factors using a two-dimensional scaling of both the extent and their perceived impacts in case of occurrence on the selected projects. The Likert-type scale to be used for the two-dimensional scaling questionnaire is defined in line with (Larkin *et al.*, 2012; Odeyinka *et al.*, 2012) as follows:

0 – no likelihood of occurrence and no impact,
1 – very low occurrence and very low impact,
2 – low occurrence and low impact,
3 – medium level of occurrence and medium impact,
4 – high level of occurrence and high impact,
5 – very high level of occurrence and very high impact.

This will give the measuring scale the property of an interval scale which would make the collected data suitable for various statistical analyses. Also, this will involve an epistemic approach to risk as respondents will be expected to do their scoring based on their experience of past projects. From this information, the significant risk factors that impact on the variability between design stage elemental cost plan and final tender sum will be determined using mean ranking analysis.

The second stage of the research will involve secondary data collection of elemental cost plan and final tender sum data from some case study projects. The previous respondents will be requested to provide further information on some traditionally procured building projects. Specifically, Project Quantity Surveyors who worked or are still working on such projects will be approached and requested to score the extent of occurrence of the identified significant risk factors on a Likert-type scale. This stage of data collection will concentrate on the significant risk factors identified in the first stage of data collection. A project-by-project approach to data collection will be adopted whereby comprehensive data regarding each case study project will be collected. Data from the case studies will be used to develop a predictive model for assessing how complex interaction of risk factors combines to impact on the variability between the design stage elemental cost plan and final tender sum in traditionally procured building projects. The model will be developed using multiple regression analyses. The developed model will be tested and validated using Delphi process and Experts' consensus to determine its accuracy and predictive ability as well as practical relevance to construction industry practitioners.

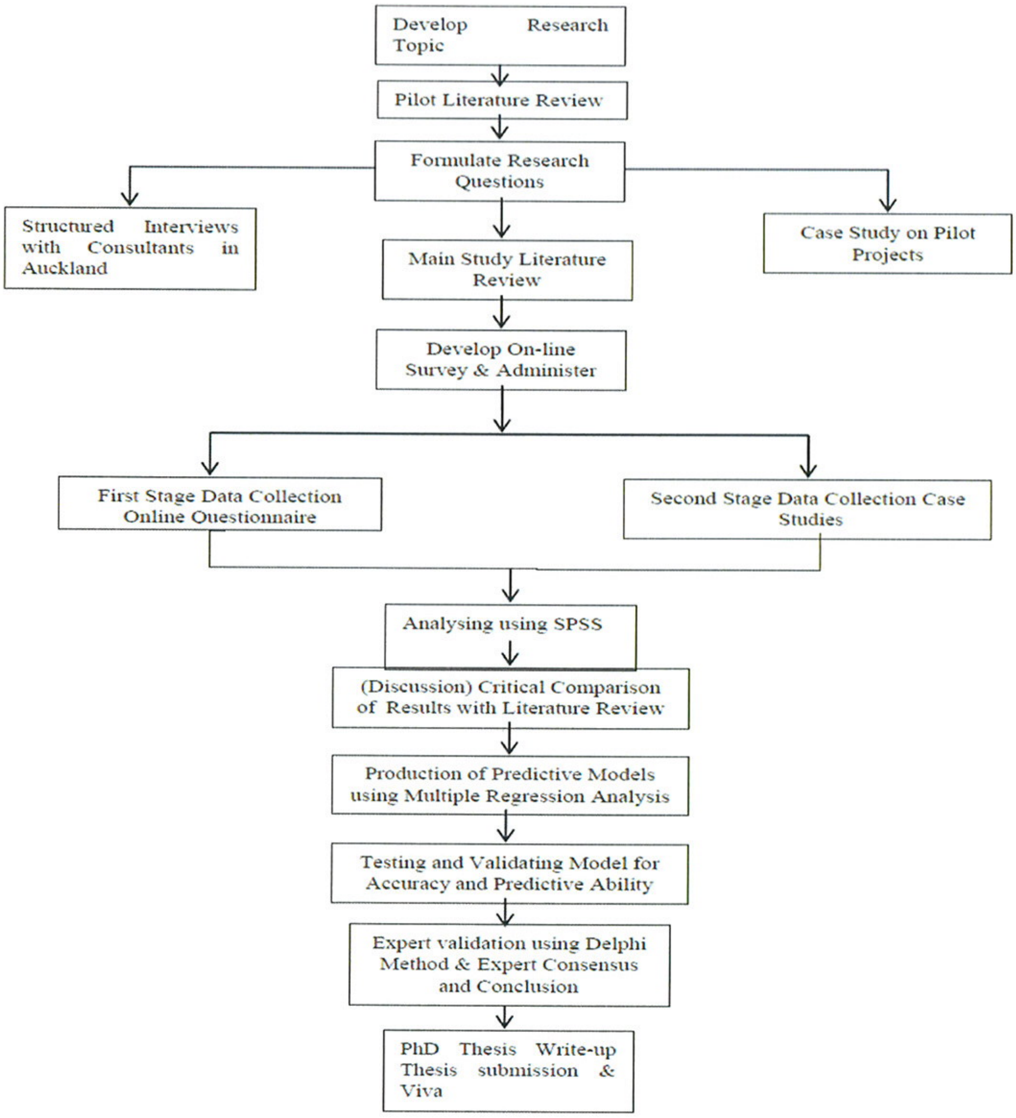

Figure 2: Research Design

CONCLUSION

The aim of this paper is to provide a preliminary literature review, prior to a full research project aimed at developing a predictive model that will assist construction industry practitioners in New Zealand to have a better and reliable prediction of final tender sums of building projects from the elemental cost plans. Extant literature has indicated that risks have an impact on the deviations experienced during the design development stage 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 review of relevant literature suggests that the essence of having an elemental cost plan as a reliable budgetary tool that guarantees cost certainty for building projects is secured if the risk elements are properly evaluated.

The approach envisaged in the later part of the research when data are collected and analysed will provide information for the development of a predictive model for application in New Zealand. The study will clarify the issues involved at different stages of data collection and analysis which need to be given due consideration. Further work on this proposed study will clarify the data analysis methods which would be useful to accomplish this study and also taking into account the appropriate modelling technique.

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