Appraisal of risk contingency planning for construction projects

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Abstract. Risk contingency plan in a construction project allows for flexibility and effective responses to change orders and unforeseen risks arising at the construction phase of projects. A poor risk contingency allowance can result in cost overrun on a project as well as time overrun. However, a good risk contingency plan can be tailored based on the previous similar projects while taking into consideration the individuality of that particular project. The aim of the study is to review risk contingency planning for construction projects. Secondary data was used in carrying out this research study. Extant literatures were reviewed carefully for proper understanding of the methods used in carrying out risk contingency estimation, the importance of risk contingency to construction projects, the categories of risk contingency plans and the factors affecting the accuracy of risk contingency for construction projects. The study revealed and concluded that risk contingency serves as the extra budget that caters for uncertainties which can lead to cost overrun on construction projects thereby affecting the accuracy of the preliminary estimate. It was recommended that risk evaluation must be done appropriately at the planning phase of the construction project, so that the estimator can have more information necessary to factor into the estimation process thereby increasing the accuracy of the estimate prepared.

Keywords: Construction Projects; Contingency; Project Planning; Risks.

1. Introduction

In a construction project, risk contingency planning begins with the size of the project before looking at other factors. This helps the project to establish a baseline for uncertainties within the project and defining both external and internal risks while putting appropriate measures in place [1]. Fry [2] added that risk contingency planning provides good structure to identify, quantify and put risks first thereby setting the programme for the project and allocating resources. A poor risk contingency allowance can result in cost overrun on a project as well as time overrun. However, a good risk contingency plan can be tailored based on the previous similar projects while taking into consideration the individuality of that particular project. By definition, risk contingency is a quantity of money that is enclosed during a budget to represent uncertainty [3]. Bello [4] stressed further that contingencies are added to development budget as an estimated fund which gives client and project team the required flexibility to cover for uncertainties and risks that may affect the completion of set project objectives. To the project owner, it serves as the extra budget that caters for uncertainties which can lead to cost overrun. Most projects and operational functions usually run into unexpected costs, therefore, it is common that...
unexpected costs can be expected. As such, having a risk contingency in a budget may be a normal application in several projects [5].

2. Literature Review

In estimating the cost of contingency for construction projects, there are two approaches. According to [6], these methods are deterministic and probabilistic methods. The deterministic method is a traditional method is mostly employed for estimating risk contingency for construction projects. The deterministic method usually express risk contingency in terms of a certain percentage of the contract sum or subcomponent of the project [7]. The percentage of the contingency for a construction project is fairly high at the initial phase of the projects where there is a higher number of potential risks. However, the percentage decreases as more project particulars regarding the scope of work are made available by the project team [6–8]. The allowed percentage is dependent on the potential risks attached to the project at hand. For projects in which an allowance is made for risk contingency, it was observed that there is an average of 5.07% cost overrun compared to 9.52% cost overrun on projects without risk contingency allowance [9]. Usually, deterministic method uses a percentage between 5 and 10% of the project cost for contingency. This is always unjustified as the degree of certainty cannot be established and therefore puts contractor at the risk of overcompensation and most times underpayment for uncertainties.

Probabilistic method of estimating risk contingency deals with project cost components being assigned probability distribution functions (PDF) thereby generating a PDF for the overall project cost through summative process [5]. This process is achieved by breaking down the project overall cost down into element components. The PDF assigned to each component describes the actual values of the component if the same project is to be executed more than once. This, therefore, gives a cumulative value for the overall project cost indicating a possible decrease or increase in the construction cost based on the changes to the cost components [6]. There are different approaches to carrying out the probabilistic method of estimating risk contingency among which are Expected Value approach (EV), Method of Moment (MM), Monte Carlo Simulation (MCS) etc [5,10]. Expected Value approach assumes that all risks associated with a construction project are adequately identified. Their impact value on the project and their probability of occurrence are also identified. These risks are therefore classified into variable and fixed risks with fixed risks representing risks that will either happen completely or not and variable risk representing risks that the extents cannot be determined [6]. All the risks are then evaluated based on their maximum and average risk value. The average risk values accumulated is the risk contingency value for the project [6]. According to [10], Method of Moment approach takes a step further from the Expected Value approach by calculating the standard deviation for each risk together with the average and maximum risk values. Central limit theorem is therefore used to check if the total project cost (i.e. the summation of the Expected values) follows a normal distribution, then z scores from a normal distribution probability table is applied to derive the contingency cost at a specified confidence level. In Method of Moment, final construction cost is expressed as a continuous probability distribution, unlike Expected Value which expresses it as a static figure [10]. Monte Carlo Simulation (MCS) on the other hand simulates the construction project through about +1000 trials and assigns a chosen value to each cost component depending on the parameters and shape of the probability distribution. Each trial’s cost component values are summed up to give the project cost. Iteration is then carried out using different values for the components which are all recorded to get project costs. Monte Carlo Simulation has been adjudged to be more effective than the other approaches as it is simple, easy-to-use and understandable. It also accommodates estimating threats, uncertainties, and opportunities [6].

2.1. Importance of Risk Contingency in Construction Projects

In the construction industry, planning is a key activity to be embarked upon in order to achieve unfaltering quality in the project. Risk contingency planning reveals to a property developer what amount of money is to be set aside for risks associated with a project. Likewise, risk contingency
planning reveals when the typical expense shall more likely than not happen. The data is fundamental for achieving the project’s monetary information and for choosing if an enterprise can bring money to the project. Without risk contingency planning, the clients’ obligation will become unpredictable which can result in project cost overruns [1]. Amade [11] submitted that most construction projects fail due to unforeseen costs and budget overruns, which are not considered or adequately allowed for at the planning phase.

Cost overruns in a project can be shown to be the signs of poor quality of budget preparation for the project and poor planning resulting from the accuracy of information or data used for determining the budgets of the project. In construction projects, the use of risk contingency provides a lucid and lively recognition of upcoming and impending challenges of cost underrun/overrun in delivering the project. The effective use of risk contingency in construction project provides an unmistakable and striking assurance of looming utmost matters of contingencies in the delivery of the projects [11]. The occurrence of underrun/overruns in the cost of construction projects is a common problem worldwide. Such frequency of cost overrun is normally the wellspring of contention amongst clients, professionals as well as contractors. The absence of a steady and dependable technique for deciding risk contingency without the use of stochastic approach regularly prompts cost and time overrun, which frequently result in delay in construction projects [12]. The substantial way of looking out for the issue of cost underrun/overrun is to incorporate a particular percentage of the total project cost as contingency before finalising the contract budget. Aibinu [13] additionally expressed that the traditional way to deal with the issue of uncertainty is to evaluate the project in view of judgmental elements. When the contingency sum for a construction project is extravagant, it has a tendency to result in poor cost management. This can prompt the project winding up uneconomically or tying up funds making it inaccessible to utilise for other projects. Also, if the contingency sum is inadequately estimated, project finance becomes excessively rigid. At the completion phase of the project, an impossible budgetary condition is met. This will, therefore, result in unpresentable project delivery or project abandonment [12].

2.2. Categories of Construction Project Risk Contingencies
Risks are part of construction projects which cannot be overlooked. These risks are encountered at different phases of construction projects and proper measures need to be put in place to cater for these risks which come in form of risk contingency. Risk contingency, therefore, covers for schedule delays, unexpected change orders and/or uncontrollable factors attached to the construction project. Risk identification is a major process which enhances risk management ability and determination of risk contingency allowance [14]. Adafin [15] highlighted the identified key elements of risks to be evaluated and apportioned the right cost for incorporation into the construction cost as laid out in RICS New Rules of Measurement 1. The costing of these risks depends largely on the phase at which the estimate for the construction project is prepared and are therefore subjected to review upon accomplishment of each phase of the construction project. These risks are categorised into four which are noted below:

- **Design Development Risks**: These risks are commonly experienced in the design phase of construction projects. These risks are affiliated with the design development; third-party risks (such as legal agreement, environmental issues, planning requirements, covenants, and pressure groups); procurement methodology; changes in estimating; delays in tendering; and statutory requirements; inadequate brief; incomplete drawings.
- **Employer Change Risks**: These are risks which can be experienced during both design process and construction process basically brought up by the employer due to some change in taste or scope of the project. Risks such as change in quality; change in brief or scope of work; and change in time schedule.
- **Construction Risks**: These risks are affiliated with the construction process which includes ground conditions; site conditions (such as existing infrastructure, existing occupants/users, access
limitations/restrictions, boundaries); inflation; disputes; statutory undertakers; and existing services.

- Employer Other Risks: These are risks that can come up at any phase of the construction project from inception to final completion springing up from the employer. These risks include postponement; early handover; improper tender action; liquidated damages; acceleration; peculiar contract arrangement; and funds availability.

The study of [16] also corroborated these key elements of risks which are to be evaluated and apportioned the necessary cost before the project is executed.

2.3. Factors Affecting Risk Contingency for Construction Projects

There are various research studies on the numerous factors that affect the accuracy of risk contingency estimate for construction projects among them are [12,16–19] According to [17], eight (8) factors were identified via an interview with project managers that affect risk contingency estimate for construction projects. These factors include short bidding time frame, contract size, tough bidder mentality, owner’s reputation, workload, number of bidders, unclear contract documents, and project complexity.

In [18] survey, 59 factors were identified among which bureaucratic difficulties, unavailability of qualified workforce, indistinctness of contract conditions as regards claims as a result of delays in payments, design complexity, strict contract conditions, poor productivity of labourers, and high inflation rate ranked highest. [12] identified incomplete or undefined scope and specification changes, design completeness and status, differing site conditions, and change in scope as the major factors affecting the accuracy of risk contingency estimates. All the identified factors are related to scope definition and poor design. According to [19], 61 factors were identified from different literatures which were categorised into 12 sub-headings. These sub-headings include factors that are related to owner/consultant, environmental, political, economic, related to bidding, related to construction, related to project, related to contractor, related to design, related to resources, technical/managerial, and legal factors. Political factors ranked highest followed by economic-related factors, owner/consultant-related factors, contractor-related factors, and design-related factors respectively.

Nawar, [16] observed eleven (11) factors affecting time and cost contingency with amount of change order ranking highest. Level of constructability, project manager management capability, scope clarity and definition, allowed time for project planning, market stability, contractor’s experience, schedule accuracy, financial capability of owner, project complexity, and investigation of site condition are the other identified factors affecting time and cost contingency of construction projects in the Egyptian construction industry.

3. Lessons Learnt

Risk contingency plan in a construction project allows for flexibility and effective responses to change orders and unforeseen risks arising at the construction phase of projects. This begins with the size of the project before looking at other factors which, therefore, helps the project to be able to establish a baseline for uncertainties within the project. A good risk contingency plan can be tailored based on the previous similar projects while taking into consideration the individuality of that particular project. For a risk contingency plans to be effective, it must establish several situations which will cowl certain activities the project can lay hold to beneath bound conditions. These situations embrace numerous degrees of activity, grounded on the dimensions of these events. Risk contingency can be estimated in two ways which are deterministic and probabilistic methods. The deterministic method is a traditional method which usually express risk contingency in terms of a certain percentage of the contract sum or subcomponent of the project. Probabilistic method, on the other hand, deals with project cost components being assigned probability distribution functions thereby generating a probability distribution function for the overall project cost through summative process. When there is no adequate risk contingency planning, clients’ obligation becomes unpredictable which can result in project cost overruns. Since most construction projects fail due to unforeseen costs and budget overruns which are not considered or adequately allowed for at the planning phase, cost overruns are
therefore, indications of poor quality of budget preparation and poor planning. Risks on construction projects can be categorised into four classifications which are Employer Change Risks; Design Development Risks; Employer Other Risks; and Construction Risks. All these risks can, therefore, be evaluated and apportioned the right contingency such as Project Planning Contingency; Project Design Contingency; Project Contract Contingency; and Project Construction Contingency. Some factors affecting the risk contingency for construction projects are related to owner/consultant, environment, politics, economy, related to bidding strategy, construction method employed, project attributes, contractor capabilities and experience, design complexity, resources available, technical/managerial ability, and legal factors.

4. Conclusion and Recommendation
The study has carefully established the essence of making risk contingency plan for construction projects which will help the project in establishing a baseline for uncertainties within the project. It is concluded that risk contingency serves as the extra budget that caters for uncertainties which can lead to cost overrun on construction projects thereby affecting the accuracy of the preliminary estimate. The study recommends that risk evaluation must be done appropriately at the planning phase of the construction project, so that the estimator can have more information necessary to factor into the estimation process thereby increasing the accuracy of the estimate prepared.

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