Project Cost Control for Effective Risk Management in Nigeria Construction Industry

Francis Joseph, Kingsley Egwu, Mascot Agbo and Ezekiel Nnadi

Department of Quantity Surveying Enugu State University Science and Technology, Agbani

ABSTRACT
This study assesses the effect of cost control on risk management in construction industry in Enugu State specially to know if adherence to project cost control increases risk management effectiveness and to know if project cost control reduces abandonment and under completion of project. Two alternate hypothesis were formulated. The study used survey design whereby data were collected from the sample considered to be the representative of the population. Data collected were presented in tables containing frequencies of the responses and their corresponding percentages. The hypothesis of the study was tested using chi-square (X^2) statistical tool and the results of the analyses revealed that effective project cost control improves the quality of risk management practice with chi-square value of (6.166) which is greater than the critical value and that Effective risk management through cost control reduces conflict among construction team members with chi-square value of (11.499). The study also revealed that adherence to project cost control approach increases risk management effectiveness in Nigeria Construction Industry and reduces project abandonment and under completion of project. The study concluded that Cost control is needed in the construction project management field because of the high level of uncertainty associated with the cost of building complex structures. It is recommended in the study that Nigeria Construction Industry should stick to project cost control approach to increases risk management effectiveness in construction project delivery to enable conflict reduction among construction team members.

Keywords: Project, control, effective, risk, management, construction, industry, Nigeria.

INTRODUCTION
The cost of any construction project is a major concern for any owner, yet details and information can be missed by an inexperienced team or by professional interference. An estimator is responsible for determining the cost and the type of material required for a project. The cost of equipment and labour and to predict the duration of the project. As the project progresses, the estimator can provide accurate cost which allows the owner to make better decisions and keep the project on schedule and budget. If the estimator is involved too late in the design phase of the project, the benefits of the estimating process will be missed. For some major projects, particularly, design - build the design, construction, and project control teams work together to develop the design, estimates, budgets and schedules in conjunction with each other of not concurrently [1]. Integrated cost and schedule risk assessments can flourish in this environment. Estimating and risk assessment techniques can be applied to a project to provide more realistic assessment of the cost while identifying risks and providing the time and opportunity to mitigate or accept them. Construction and cost engineering professionals have long area of cost control need for improvement in cost control estimating, scheduling, accumulating and analyzing cost data, and finally implementing measures to
correct a cost problem. There are several cost controls [2].

**Statement of General Problem**
The increase in the number of abandoned, uncompleted and under completed projects and cost overrun by individuals, companies and even government has been a cause for serious concern. This high rate of abandonment plus dispute among construction team member has inflicted infrastructural development negatively and may have dissuaded prospective investors from investing in our economy. Cost control is need in the construction project risk management field because of the high level of uncertainty, associated with the cost of building complex structure. In this era, effective cost control is a vital factor in risk management in Nigeria dispute among construction team members to reduce the level of project abandonment and cost and time overrun [3].

**Aim and Objectives of the Study**

**REVIEW OF RELATED LITERATURE**
A prepare cost control procedures combined with risk assessment provides the opportunity to identify and control cost during the development of the project. A cost control techniques to highlight potential areas prone to cost escalation is presented. The literature abounds with definitions of risk. Risk can be a somewhat ambiguous term unless its definition and convention are clearly stated. The concept of risk is used to assess and evaluate uncertainties associated with an event. Risk can be measured as a pair of the probability of occurrence (likelihood) of an event and the consequences (outcomes) associated with the event's occurrence [4] [5]. This pairing is not a mathematical operation, a scalar or vector pated quality. But a matching of an event's likelihood or occurrence with the expected outcome. The generally accepted expression for risk is shown in Equation 1 [6]. Risk $P_i, C_i, P_j, C_j, ..., P_x, C_x$ (equation 1)

In this equation $P_x$ is the occurrence probability of event $x$, and $C_x$ is the occurrence consequences or outcomes of event $x$. the consequences of a risk event in the project management field will most likely be in terms of Naira. Risk is sometimes thought as the potential for harm. In a project management context and as defined in this paper risk is thought of as being concerned with opportunities or potential gain as well as negative consequences. This broader risk definition is known as risk engineering [7]. There is a consensus within the technical community that a comprehensive risk analysis consists of risk assessment, risk management, and risk communication (National Research Council, 1983). Risk assessment is the process of identifying and evaluating areas of risk. Risk management is the act or practice of dealing with or controlling this risk, risk can be managed based on the information provided from the risk assessment to determined risk acceptability and using decision analysis to make risk informed decisions for control and mitigation purposes [8]. Risk communication is the process of documenting and exchanging information about the results of risk studies to various interested parties.
Risk assessment

Risk assessment is a technical and scientific process by which the risk of given situations for a system are modeled and quantified. Risk assessment provides qualitative and quantitative data to decision-makers for later use in risk management. Risk assessment for construction projects can be performed by comparing the resources requirements simulations of the construction processes. These techniques highlight the critical cost areas and opportunities for savings. When data does not exist, or is unavailable, a construction risk assessment can be made in qualitative terms. Where data exists, or can be obtained, the risk assessment is quantitative [9]. The risk assessment then considers deviations from these construction scenarios that can lead to undesirable or positive consequences. The consequences can be described in terms of adverse or positive impacts to a project's cost, schedule, safety, or technical performance. Qualitative risk analysis uses expert opinion to evaluate the probability and consequence of an event's occurrence. Safety review/audit, checklist, what-if, Hazard and operability study (HAZOP), Preliminary Hazard analysis (PrHA), risk assessment matrix table, analytical Hierarchy process (AHP), Consequence assessment and cause consequence diagrams, expected Monetary value (EMV) using the Delphi technique. Quantitative analysis relies on statistical methods and database that determine the probability and consequence of an event. Simulation, Failure causes scenarios, sensitivity factors, fuzzy stochastic applications, risk premium. EMV and expected Net Present value (NPV), risk adjusted rate of return, and stochastic dominance are generally considered quantitative risk assessment techniques [10].

Risk Management

Risk management is the process by which system operators, project managers, and owners make decisions, changes, and choose different system configurations based on the data generated in the risk assessment. Risk management is also dynamic as new information about risk events become available managers should adjust accordingly. To make decisions based on risk, a level of acceptable risk must be determined. Management should determine risk acceptable through a systematic process that may be project specific, based on general corporate or governmental guidelines. Risk acceptance can also be determined by the cost effectiveness of risk reduction or opportunity gained. This cost effectiveness is calculated as:

\[
\frac{N_{\text{Risk}}}{\#\text{Cost}}
\]

Cost Effectiveness for risk equation 2

Where \(N_{\text{Cost}}\) is the monetary amount required to reduce risk and \(N_{\text{Risk}}\) is the level of risk reduction. An integral part of risk management is the use of decision analysis. Project management and engineering are professions that require decisions to be made for the management cost, schedule technical, and safety risks. Most decision analysis techniques have the following steps or phases: (1) identify the problem and objectives, (2) develop alternatives, (3) evaluate the alternatives, and (4) implement the best alternative [11] [12]. in a risk -based decision analysis these steps should include the uncertainties associated with the data or alternative. Four possible decision analysis methods that can be used in a risk based decision analysis methodology are: (1), decision trees, (2) goals trees, (3) analytic Hierarchy Process (AHP), and (4) risk - based Net present value (NPV).

Design and Price Risks in Construction

[13] opined that design risk is one of the risks factors in construction contract administration. Design risks can occur due to lack of information on the project. This design risks when it occurs can affect the client negatively because it might involve additional expenditure, which leads to contract overrun, inability to complete the project within the stipulated time frame or it could lead to abandonment of the project. In some situation, the project could be financed through financial institutions to be repaid within a specified time limit. It is important to secure adequate information
about the project and the statutory requirements for such a project before commencing on the design. There is the need to secure all the necessary brief from the client before detail design are carried out.

**Risk - Based Cost Control**

A cost control technique that anticipates potential cost issues by using risk analysis and simulation techniques to highlight potential areas prone to cost escalation is presented. This risk analysis is also used to highlight areas where cost savings or a competitive advantage may be gained. Risk analysis information along with cost forecasting tools is combined to anticipate a project’s problems and completion costs [14]. The presented methodology is applied in the planning and execution phase of a project. Risk methods are used to help establish cost and schedule targets in the planning phase. A project’s cost is a function of schedule and the integration of cost and schedule is an important part of the methodology.

In the execution phase risk methods are applied to help managers control projects with the goal of delivering them on budget and schedule. The presented risk analysis is a combination of both qualitative and quantitative risk methods. In the risk assessment phase the probabilities and consequences of risk or opportunities are quantified and using a risk assessment matrix table a determination of risk is made. Once an expression for the likelihood and consequence of an event is developed a risk rating can be determined. For example, if the likelihood of a labour strike is likely and the consequence of this event is critical, the risk rating for a labour strike will be high”. Risk ratings are then compared to risk acceptance levels and a decision analysis process in used to assist management [15].

**Planning Cost and Schedule Risk Assessment**

**METHODOLOGY**

The researchers used a descriptive survey design and data were collected through structured questionnaire from the sample considered to be the representative of the population through simple random, purposive and stratified sampling techniques, and these data were complemented by oral interview.
conducted among selected members of the sample. 50 construction firms comprising of building civil engineering firms, general building contractors, general civil engineering contractors were selected for the study; however, 48 completed questionnaire were retuned [15]. The rate of responds in this study was 96%. Data collected were analyzed using frequency distribution and percentage, standard deviation, and chi-square. Chi-square statistical tool was used to test the hypothesis of the study

$$X^2 = \sum \frac{(O-E)^2}{E}$$

Where; $$X^2$$ = Chi-square; E= expected frequency; \( \Sigma \)=summation; O=Observed frequency

Table 1: Questionnaire Distribution to: Ascertain the effect of cost control on risk management in Nigeria Construction Industry.

<table>
<thead>
<tr>
<th>S/n</th>
<th>Items</th>
<th>Responses options (O) and their percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adherence to project cost control approach increases risk management effectiveness in Nigeria Construction Industry</td>
<td>20 41.67 18 37.50 7 14.58 3 6.25 48 100</td>
</tr>
<tr>
<td>2</td>
<td>Project cost control reduces project abandonment and under completion of project</td>
<td>18 37.50 25 52.08 3 6.25 2 4.17 48 100</td>
</tr>
<tr>
<td>3</td>
<td>Effective risk management reduces cost and time overrun in project delivery</td>
<td>22 45.83 15 31.25 6 12.50 5 10.4 2 48 100</td>
</tr>
<tr>
<td>4</td>
<td>Effective project cost control improves the quality of risk management practice</td>
<td>15 31.25 17 35.42 10 20.83 6 12.5 0 48 100</td>
</tr>
<tr>
<td>5</td>
<td>Effective risk management through cost control reduces conflict among construction team members</td>
<td>15 31.25 20 41.67 8 16.67 5 10.4 2 48 100</td>
</tr>
</tbody>
</table>

Source: Researchers 'Field Survey, 2019
**Test of Hypothesis**

Table 2: Contingency Table from item 4 in table of the questionnaire distribution

<table>
<thead>
<tr>
<th>S/n</th>
<th>Items</th>
<th>Responses options (O) and their percentages</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A %</td>
<td>D %</td>
</tr>
<tr>
<td>1</td>
<td>Effective project cost control improves the quality of risk management practice</td>
<td>15</td>
<td>17</td>
</tr>
</tbody>
</table>


\[ X^2 = \sum \frac{(O-E)^2}{E} \]

Where; \( X^2 \) = chi-square; \( E \)=Expected frequency; \( \Sigma \)=Summation; \( O \) = Observed frequency

Table 3: Chi-square (X2) Table calculated from the contingency table

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Options (O)</th>
<th>Expected Frequency (E)</th>
<th>O-E</th>
<th>(O-E)^2</th>
<th>( \frac{(O-E)^2}{E} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA1:</td>
<td>15</td>
<td>12</td>
<td>3</td>
<td>9</td>
<td>0.750</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>12</td>
<td>5</td>
<td>25</td>
<td>2.083</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>12</td>
<td>-2</td>
<td>4</td>
<td>0.333</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>12</td>
<td>-6</td>
<td>36</td>
<td>3.000</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td></td>
<td></td>
<td>6.166</td>
<td></td>
</tr>
</tbody>
</table>


Table 4: Contingency Table from item 5 in table of the questionnaire distribution

<table>
<thead>
<tr>
<th>S/n</th>
<th>Items</th>
<th>Responses options (O) and their percentages</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A %</td>
<td>D %</td>
</tr>
<tr>
<td>1</td>
<td>Effective risk management through cost control reduces conflict among construction team members</td>
<td>15</td>
<td>20</td>
</tr>
</tbody>
</table>


\[ X^2 = \sum \frac{(O-E)^2}{E} \]

Where; \( X^2 \) = chi-square; \( E \)=Expected frequency; \( \Sigma \)=Summation; \( O \) = Observed frequency
Table 5: Chi-square ($X^2$) Table calculated from the contingency table

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Options (O)</th>
<th>Expected Frequency (E)</th>
<th>O-E</th>
<th>(O-E)^2</th>
<th>(O-E)^2 / E</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA1:</td>
<td>15</td>
<td>12</td>
<td>3</td>
<td>9</td>
<td>0.750</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>64</td>
<td>5.333</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>12</td>
<td>-4</td>
<td>16</td>
<td>1.333</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>12</td>
<td>-7</td>
<td>49</td>
<td>4.083</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>48</strong></td>
<td></td>
<td></td>
<td><strong>11.499</strong></td>
<td></td>
</tr>
</tbody>
</table>


FINDINGS

During our investigation, the following findings were made on the effect of cost control on risk management in Nigeria Construction Industry.

1. Table 1 shows that adherence to project cost control approach increases risk management effectiveness in Nigeria Construction Industry with about 79.3% of the total respondent that agreed to the fact while only 20.7% disagreed to it.

2. Table 1 also shows that Project cost control reduces project abandonment and under completion of project according to the respondents, 89.58% of the respondents agreed to it while 10.42% disagreed to the fact. This confirmed that project cost control reduces project abandonment and under completion of project.

3. It can also be noticed that effective risk management reduces cost and time overrun in project delivery, a total of 77.08% of the respondent confirmed to that fact because when risk is managed effectively its tends to reduce the overall cost and time overrun but 22.92% disagreed to it.

4. As shown in table 1, majority of the respondents (66.67%) agreed that effective project cost control improves the quality of risk management practice while (33.33%) disagreed to it. It is also proven in table 3 that effective project cost control improves the quality of risk management practice with chi-square value of (6.166) which is greater than the critical value.

5. Effective risk management through cost control reduces conflict among construction team members with chi-square value of (11.499)

RECOMMENDATIONS

In view of the foregoing, the study therefore recommends as follow:

1. Nigeria Construction Industry should stick to project cost control approach to increases risk management effectiveness in construction project delivery

2. To reduces project abandonment and under completion of project in Nigeria Construction Industry effective cost control on risk management is required.

3. construction team members should employ effective risk management through cost control to enable reduction of conflict among the team

CONCLUSION

Cost control is needed in the construction project management field because of the high level of uncertainty associated with the cost of building complex structures. Although there is a potential for a project to be completed under budget, the complexity involved in construction requires specific attention to cost control to achieve favorable results. To be the most effective over the lifecycle of a project, a cost control approach must be applicable to both the planning and
execution phases. The approach needs to be adherent to project to increases risk management effectiveness. Risk-based cost control methodology was presented that combines simulation, earned value, and risk analysis techniques in a novel approach to control. This proposed methodology provides construction project managers with a structured framework to make cost control decisions during the planning and execution phases of construction.

REFERENCES


