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DETERMINATION OF CONTINGENCY SUM FOR BUILDING PROJECTS IN GHANA

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ABSTRACT

The building industry is always surrounded by many risks and uncertainties and their degree in a project results from a combination of factors which differ from one project to another. One of the attempts to handle risks is by allocating project contingency sum. Traditionally, construction professionals determine cost contingency simply by adding; say 10% contingency onto the estimated cost of a project. However, this conventional method is arbitrary arrived at and difficult to justify or defend and coupled with so many associated weaknesses. The aim of the study is to investigate into methods of determining project cost contingency. The specific objectives are : to identify the existing method(s) of determining project contingency sum in Ghana and to identify the factors influencing the determination of building project contingency sum in Ghana This study has adequately reviewed some methods of determining project contingency sum, factors that influence the determination of project contingency sum in Ghanaian construction industry and elsewhere. A random sampling technique was used to select a sample size of 92 construction professionals practicing. A total of Ninety-Two (92) questionnaires were distributed to the respondents in the building industry out of which 67 representing 72.9% were completed and returned. The collected data on factors were analyzed using the relative important index (5 - most important and 1 - least important rankings). The study identified Deterministic approach (percentage addition) as the most widely known and used method by the construction experts in making provision for contingency. Unexpected ground conditions (substructure works), design consideration, project duration and project specification have also emerged as the most influencing factors.

Keywords: Determination, Contingency Sum, Building, Projects, Ghana

INTRODUCTION

The aspiration and expectation of building clients and consultants is to keep the final construction cost within the initial budget estimate or approved expenditure that include an additional amount that caters for uncertainties and risk events which amount to variation. In construction, projects plans and cost estimates are usually drawn to ensure that the work is carried out to the desired quality, within allowed time, and within budget. Invariably unforeseen items and events in the execution of any building project are inevitable.

In Ghana, the construction industry has been criticized for increasing costs, Low productivity, quality problems and project delays. As construction projects are characterized by many and varying uncertainties, the ability to manage risks throughout the construction process is an important and central element preventing unwanted consequences. The successful completion of any project is also assessed on the basis of



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three parameters, which constitute risks namely; time, money and performance which according to Smith (1999) are the three types of contingencies. Cost contingency is included within a budget estimate so that the budget represents the total financial commitment for the project sponsor. Therefore the estimation of cost contingency and its ultimate adequacy is of critical importance to projects (Baccarini, 2005). Contingency allocation has been the subject of various researches likewise various methods of contingency calculation and allocation have been a worry. There is no project budget without a Contingency sum. One of the more common methods of budgeting for contingency is by considering a percentage of the estimated cost based on previous experience with similar projects. Contingency Sum is an integral part of the total estimated costs of projects. It has been defined as additional funds to cater for unforeseeable elements of cost within the defined project scope (Ford, 2002; AACE, 2000).

Contingency Sum may be derived either through statistical analysis of past project cost or by applying experience gained on similar projects. Projects which cannot be defined adequately require high contingency sum. More so, contingency sum decreases as the project progresses.

Risk is inherent in all human activities including construction work(s) and risk elements are diverse and varied (Odeyinka *et al.*, 2006) Risks and uncertainties are some of the inherent difficulties which arise during construction process. The degree of risk in a project may result from a combination of factors and these factors differ from one project to another. Accordingly, there is no construction project that can be undertaken without an element of risk (Kwakye, 1997). In the construction industry, risk is defined as an exposure to economic loss or gain arising from involvement in the construction process. Some of the major risks in construction at project level include physical risk, environmental risk, logistic risk, legal risk, political risk and financial risk, among others (Odeyinka *et al.*, 2006). Regardless of the complexity of factors, the degree of detailed design to produce an accurate estimate is an important factor (AACE, 2000).

Problem Statement

In most construction, too often risk is either ignored or dealt with in an arbitrary way by adding a percentage allowance in a form of contingency sum onto the estimated cost of construction project to cater for changes that experiences show are likely to occur without considering the project variables which is typical and unscientific (Thompson and Perry, 1992).

In Ghanaian construction industry, Project Contingency Sums have been across board percentage addition to base estimate. This method is derived as a result of past experiences, intuition and sometimes historical data without much scientific bases (Baccarini, 2004). It is usually illogically arrived at and may not be appropriate for the proposed project. This



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judgmental and arbitrary method of contingency calculation is difficult for the estimator to justify or defend (Yeo, 1990). It is an unscientific approach and the reason why so many projects are over budget (Hartman, 2000). Though the method is simple, it has resulted into some problems including delay in completion of projects, loss of capital and some litigations as well as abandonment of projects. Contractors are also faced with high interest rates on loans, high cost of project overhead and loss of profit. Most cost and time overruns are attributable to this method. The Ghanaian contractors have also been accused of not been able to deliver completed projects to specifications and quality standards. While these concerns may be valid, they are often based on the perceptions of the people making these claims and could be described as anecdotal. With these concerns one may ask, what basis can be used to objectively deal with factors that influence the determination of contingency sum? It is to answer some of these questions that there is the need to propose a rating mechanism within which an objective assessment of what constitutes a good or acceptable contingency for projects in the construction industry can be made and legitimized. It is against this background that it has become necessary to find out existing methods of determining Contingency Sums, assess project factors and develop a system to serve as basis for construction contingency estimate in order to achieve better level of accuracy and reliability as well as to promote management of Contingency Sum and contract security in Ghana.

Aim of the study

The aim of the study is to investigate into methods of determining project cost contingency and the associated factors influencing the determination of contingency sum for building projects.

Objectives of the study

The specific objectives are : to identify the existing method(s) of determining project contingency sum in Ghana; to review the existing approaches of estimating project cost contingency; to identify the factors influencing the determination of building project contingency sum in Ghana and to develop a rating mechanism of the factors that could be used for determining a contingency sum.

Methods of determining project contingency sum

Contingency Sum is an integral part of the total estimated cost of a project. It has been observed that "contingency" is probably the most misunderstood misinterpreted and misapplied word in project execution (Patrascu, 1988). It has been defined by the American Association of Cost Engineers (AACE, 2000) as a specific provision of money in an estimate for Unforeseeable or undefined elements of cost within the defined project scope. Further defined as "a specific provision of money or time in an estimate for undefined items which statistical studies of historical data have shown are likely to be required" (Clark and Lorenzoni, 1985).The amount of money used to provide for uncertainties associated with a



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construction project is referred to as contingency allowance (Mak and Picken, 2000). The Department of Energy of Los Angeles in the United States of America also defined Contingency Sum as provision which covers cost that may result from incomplete design, unforeseen and uncertainties within the defined project scope (Parsons, 1999). Contingency Sum as defined is a reserve of money added to the base estimated figure to achieve specific project objectives or to allow for changes that experience shows is likely to occur. It has also been defined as the amount of money or time needed above the estimate to reduce the risk of overruns of project objectives to a level acceptable to the organization (PMI, 2004).

Deterministic estimation (Traditional Percentage addition)

This is a subjective method of percentage addition on the base estimate typically derived from intuition; guess feeling, past experience and historical data. This method has been described as "Crystal ball" (Moselhi, 1997); often calculated as an 'across-the-board' percentage addition (Baccarini, 2004). The Contingency Sum is usually expressed as a percentage mark up on the base estimate, is used in an attempt to allow for the unexpected conditions (Pickens and Mak, 2001) This percentage figure that ranges from (5 to 10 %) is added to the most likely estimate of final cost of the known works. This method as reviewed, showed some weaknesses as pointed out by many researchers. The estimate is arbitrarily arrived at and difficult to justify or defend (Ahmad, 1992; Thompson and Perry, 1992) and criticized by researchers. It has been considered an unscientific approach and the reason why so many projects are over budgeted (Hartman, 2000). A percentage addition results in a single-figure prediction of estimated cost which implies a degree of certainty that is not justified (Mak *et al.*, 1998). The percentage addition does not indicate any potential for cost reduction, and may therefore hide poor management of the execution of the project. Because the percentage allows for all risks is in terms of a cost contingency, it tends to direct attention away from time, performance and quality risks. It does not encourage creativity in estimation practice, allowing it to become routine and mundane, which can propagate oversights. In fact, it is the criticism of this method that led to different methods and techniques proposed for contingency estimation as this method has several weaknesses fully described in (Thompson and Perry, 1992; Mak *et al.*, 1998; Mak and Picken, 2000).

According to the Author of this project, the objective of Contingency Sum allocation is to among other reasons ensures that the estimated project cost is realistic and sufficient enough to contain any cost incurred by risks and uncertainties. The author observed and argued that since the weaknesses of the percentage addition approach for calculating contingencies far outweigh its strengths; lack of developing creativity in estimation and unjustified way of arriving at project contingency cost estimate both by professionals and academicians at the field and in training institutions respectively tend to promote and encourage poor monitoring and management of contingency sum and contract insecurity in Construction Industry in Ghana.



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Key Attributes of The Concept of Project Cost Contingency

Reserve- Cost contingency is a reserve of money (AACE 2000).

Risk – The need and amount for contingency reflects the existence of risk in projects (Thompson and Perry, 1992). Contingency covers for two categories of risks – known unknowns and unknown unknowns (PMI, 2000; Hillson, 1999). Contingency caters for events within the defined project scope that are unforeseen (Moselhi, 1997; Yeo, 1990), unexpected (Mak *et al.*, 1998), unidentified (Levine, 1995), or undefined (Clark and Lorenzoni, 1985; Thompson and Perry, 1992).

Risk Management – There is a range of risk management strategies for risk in projects such as risk transfer, risk reduction, and financial treatments for retained risks e.g. contingency (Standards Australia, 1999). So contingency is used in conjunction with other risk treatment strategies.

Total Commitment- Cost estimates are prepared and contingencies added in order to indicate the likely total cost of the project. The inclusion of contingencies within a budget estimate means that the estimate represents the total financial commitment for a project.

Project Outcomes- Contingency can have a major impact on project outcomes for a project sponsor. If contingency is too high it might encourage sloppy cost management, cause the project to be uneconomic and aborted, and lock up funds not available for other organisational activities; if too low it may be too rigid and set an unrealistic financial environment, and result in unsatisfactory performance outcomes (Wideman, 1995; Dey *et al.*, 1994).

Two major categories of contingency.

Design Contingency– this is for changes during the design process for such factors as incomplete scope definition and inaccuracy of estimating methods and data (Clark & Lorenzoni, 1985).

Construction Contingency - this is for changes during the construction process.

Under a traditional procurement arrangement, the project sponsor procures professionals to produce the design before competitively selecting the construction contractor. A contract is signed between the project sponsor and the contractor, which typically contains a variations clause to allow for changes and provide a mechanism for determining and valuing variations (Staugas, 1995). Construction contingency exists to cater for these variations allowable under the contract between the sponsor and contractor. Mak and Picken (2000) state that contingency can be compared with the total approved value of contract variations to assess the accuracy of the contingency.



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Factors influencing the determination of project contingency sum

Accordingly, factors considered most important in making provision for construction contingency are: size and complexity of project, assessed risk on the project and adequacy of information (Bello and Odusami, 2008). Project size, type of construction, difference between low bid and owner's estimate are noted as factors that affect project cost overrun (Touran, 2003). Project size, type of construction, type of client, method of procurement, percentage of design completed before tender, adequacy of information available and number of subcontractors used are also identified as factors by (Akinsola *et al.*, 1997). In estimating for contingency, major project factors considered are project cost data and duration with their variability (Ahmad, 1992; Ranasinghe, 1994; Moselhi, 1997; Chen and Hartman, 2000; Touran 2003; Baccarini, 2005 and Rowe, 2006). It is worth noting that previous experiences relating to estimating actual cost have shown that unforeseeable events such as industrial action, fire outbreak, and incremental weather will always increase costs. It becomes more difficult to determine overall estimate reliability because some sections of a project may be completely defined at the time of estimate whilst others are only sketchily defined.

In Ghana, there are several factors that influence the cost of a project. These wide ranges of factors have been grouped into three categories namely; technical, economic and institutional or environmental factor. Two infrastructure projects will not cost the same amount no matter how similar they are. The fundamental project costs are based on the actual cost of the land, materials, equipment and labour in the region where the project is being procured (European Commission DG XVI, 1998). These factors therefore influence the determination of project contingency sum.

RESEARCH METHODOLOGY

The researcher utilized multiple research approach, involving structured questionnaire and interviews, to solicit information from the Construction Professionals. Statistics on percentage of contingency sum allocated for ten projects executed over the last five years in each, from Keta and Akatsi Municipal Assemblies respectively were sought. The total population of registered professionals in the construction industry is One thousand and eighty-eight (1088), scattered all over the country. These included 439 Quantity Surveyors and 649 Civil Engineers.

Sample and Sampling Procedures

The population size of Construction professionals was big and at the same time scattered all over the country. For the determination of the sample size from the population size for the study, Kish (1965) formula as stated below was used, $n = n \sqrt{1 + n^1/N}$

Where n = final required sample size after adjustment for the finite population, $n^1 = S^2/V^2 N$
= Population Size



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V = Standard error of sampling distribution or acceptable margin of error (i.e. level of precisions) $\pm 5\% = 0.05$, at a confidence level of 95% having a total error= 10% or 0.1.

P = The Estimate of the proportion of the population elements (P=0.5)

S² = Variance of population elements, P (1 - P) = (0.5) (0.5) =0.25.

Using the above parameters in the above equation, a target sample size of 92 professionals was arrived at. Thereafter, a proportional representation was used to allocate the questionnaires as shown in Table 1.

Table 1: Sample frame of the professionals

Professionals	No of Registered Professionals	Minimum Sample Size Required	No of Questionnaires Allotted
Quantity Surveyors	439	38	38
Civil Engineers	649	54	54
Total	1088	92	92

A Purposive Sampling Technique was then adopted to select the respondents within the country. This was because the study wanted to elicit views of professionals who have specific expertise like Quantity surveyors and Civil Engineers in the construction industry. Again, the advantage of adopting this technique is that the researcher would not be bias and also will not on his own try to defend any decisions. The implication is that, there are acknowledged experts backings of the researcher's results.

Data Analysis Procedure

The data collected were summarized and presented in a tabular form. The questionnaires which had not been retrieved were considered non-responsive. Based on the scores assigned by the respondents, the methods and factors were analysed and ranked in order to establish their criticality, relevance and level of influence in determining cost contingency for building projects in the industry. The data were manually calculated by the researcher using the relative important index (I) formula as follows;

$$\text{Relative important index (I)} = \left(\frac{100 \sum (fx)}{AF} \right) \text{ --- (1)}$$

Where, / is the frequency of score,(x) for the factor under consideration, A= highest weighting factor, (that is 5), F=total number of category respondents. The final results obtained were presented using tables, percentages and a Pie chart. All these were done in order to ensure that the responses received would be reliable.



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FINDINGS AND DISCUSSION

The relation between years of practicing and preparation of building estimate

The responses received from the various professionals based on their years of practicing in the building industry as shown in table 4.3 indicated that 80.6 % (that is from 6 years and above) of the respondents have more than six years working experience. About 100% of the respondents indicated that contingency sum is always been considered in the preparation of building budget estimate. The professionals' background and experiences are sufficient to ensure the validity of the survey results. It indicated that responses provided could be relied upon for the study.

The uses of contingency sum in the building industry

Opinions of professionals from the building industry were sought on the main uses of contingency sum. The uses and their respective percentage index are presented in table 2. Unexpected or unforeseen conditions have been indicated to be the leading element of risks in the building industry to which contingency sum is provided to cover, followed by cost overrun representing 73% and 63.6% respectively.

Table 2: Analysis of professionals' opinions on uses of contingency sum in the building industry

Uses	Rankings										\sum (fx)	%
	1	fx	2	Fx	3	fx	4	Fx	5	Fx		
Reserve fund (allowance)	27	27	24	48	11	33	5	20	0	0	128	38.2
Unexpected/ Unforeseen conditions	0	0	0	0	17	51	31	124	14	70	245	73.1
Underestimation	19	19	16	32	28	84	3	12	1	5	152	45.4
Cost overrun	0	0	19	38	24	72	17	68	7	35	213	63.6



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Table 3: Relative Important indices and rankings of factors influencing the determination of contingency sum for building works by construction professionals

Factors	Quantity Surveyors			Civil Engineers		
	$\sum (fx)$	Important Index(1)	Rank	$\sum (fx)$	Important Index(1)	Rank
X1	141	78.33	2	106	68.4	5
X2	133	73.88	4	110	71	4
X3	141	78.33	2	115	74.2	3
X4	138	76.67	3	106	68.4	5
X5	146	81.11	1	118	76.1	2
X6	146	81.11	1	125	80.6	1
X7	113	62.78	8	96	61.9	7
X8	118	65.56	6	106	68.4	5
X9	123	68.33	5	110	71	4
X10	116	64.44	7	102	65.8	6
X11	113	62.78	8	88	56.8	8
X12	99	55	9	74	47.7	9

Where (x) = Weighting of factors (ranging from 1-5)
f= frequency of responses of the particular factor.

The best estimate of true ranking of set of 'n' object is provided where 'R' is significant by the order of various sums of ranks. If one accepts the criteria used by the judges, then the best true ranking is provided by the mean score of the ranks. This implies that most factors are influencing the highest overall rankings. The mean score (indicated by the value of **(R)** calculated) among the following; Quantity Surveyors, Architects and Civil engineers is as shown in table 4 with the overall ranking for the selected professionals as also determined.



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Table 4: Agreement between Construction professionals on ranking of factors influencing the determination of contingency sum

Factors	Quantity Surveyors	Civil Engineers	Sum of Ranking (R)	Means of Ranking (R)	Overall Ranking
X1	2	5	7	3.5	4 th
X2	4	4	8	4	5 th
X3	2	3	5	2.5	3 rd
X4	3	5	8	4	5 th
X5	1	2	3	1.5	2 nd
X6	1	1	2	1	1 st
X7	8	7	15	7.5	9 th
X8	6	5	11	5.5	7 th
X9	5	4	9	4.5	6 th
X10	7	6	13	6.5	8 th
X11	8	8	16	8	10 th
X12	9	9	18	9	11 th

The details in Table 4 revealed that unexpected ground conditions has emerged as the highest ranked factor, followed by design consideration, project duration, project specification in that order as factors that have significant influence and rating in the determination of project contingency sum while force majeure emerged as the lowest ranked. In spite of the above rating, most professionals in Ghana consider Economic factors such as Inflation and Exchange Rate (Global economic pressures) as the most unstable influential factors that have varying tendency since most of them are beyond the control of the professionals, that is they come with external pressures.

CONCLUSION

Changes and risks are inevitable in construction thus, many cost and time overruns are attributable to either unforeseen events for which uncertainties were not appropriately estimated.



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The uses of contingency sum in the building industry

The study has established that contingency sum is mainly used to cater for Unexpected or unforeseen conditions and project cost overrun representing 73% and 63.6% of selected professionals respectively in the building industry.

Methods of contingency sum estimation for building works

The study established that deterministic approach (Percentage Addition) and probabilistic Estimation are the two widely known methods. 100% of respondents confirmed knowing deterministic approach whilst 71.6 % knew Probabilistic Estimating. This assertion largely has supported the revelation from the study that, the Deterministic (Percentage Approach) is the most frequent used method of determining Contingency Sum. 80% of selected construction professionals used the percentage approach and 20% used the Probabilistic Estimating. The study established that, there were other methods of determining Contingency Sum, but most professionals in Ghana were not familiar to these methods. The study considered these methods as an example, Method of moment, Range Estimating, Monte Carlo Simulation and Estimation Using Risk Analysis (ERA). Available information suggested that the respondents hardly use any of these methods for determining Contingency Sum.

Factors Influencing The Determination of Contingency Sum

The study established that by rating, the five most important factors that affect the determination of contingency sum were, unexpected ground conditions, design considerations, Project duration, project specification and project management. In spite of the above rating, most professionals in Ghana consider Economic factors (Inflation, and exchange rate) as the most unstable and have varying degrees of influence at any particular point in time in the building industry and may exert a sizeable amount of influence, since most of these factors are beyond the control of construction professionals. They come with external pressures.

Recommendations

Based on the findings from the research, the following recommendations are being made. In general much needs to be done with regards to professional education and awareness creation on the methods for and the factors that influence the determination of contingency sum for the building industry in Ghana.

Methods of contingency sum estimation for building works

The Deterministic (Traditional Percentage Method) which has emerged as the most widely and frequently used method is based on subjective approach and has many limitations. As sited in the literature review by various researchers, the estimate is judgmental, arbitrarily arrived at and its calculation is difficult for the estimator to justify or defend (Ahmad, 1992;



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Thompson and Perry, 1992) and criticized by researchers. It has been considered an unscientific approach and the reason why so many projects are over budgeted (Hartman, 2000). It is usually illogically arrived at and may not be appropriate for projects. It does not encourage creativity in estimating practice, promoting a routine and mundane administrative approach requiring little investigation and decision making. It further does not indicate any potential for cost reduction, and may therefore hide poor management of the execution of projects. This estimating method has serious flaws and is detrimental to contingency allocation and successful execution of projects in the building industry. It is against these drawbacks therefore, that professionals should explore and be encouraged to use more scientific methods such as the Monte Carlo Simulation and the Estimating using Risk Analysis (ERA). The training tertiary institutions should develop a curriculum covering more scientific methods and teach the would-be future professional students at the first degree level in that, they would be able to address the deficiencies in the industry.

The research institutions and the governing councils for the various professional associations should take up the challenge to organize workshops and seminars to introduce their members to how to work with some of the scientific methods of determining contingency and their advantages over the percentage method.

Government establishments should also develop a scientific method of estimating contingency that can be used as a benchmark for effective performance of construction contingency, as is the practice in United Kingdom and Hong Kong.

Researchers and professional bodies like the Ghana Institute of Surveyors can take up the challenge of encouraging the use of scientific methods and developing models that are reliable in forecasting construction contingency.

Factors influencing the determination of cost contingency sum

Unexpected ground conditions, design considerations, Project duration, project specification and project management have been identified as the most significant factors. The study recommends that professionals should engage in planning at the developmental stages of the project to gather all possible information to minimize the impact of technical factors and other related factors.

Attention should be given to economic factors since most of them are beyond the control of the professionals. There should also be regular meetings among professionals in Ghana to deliberate on contractual and construction risks to determine possible contingency sum for a particular period. In addition construction professionals should be encouraged to monitor the use of project contingency sum during the actual execution of the projects.



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