An experimental approach to project risk identification and prioritization

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AN EXPERIMENTAL APPROACH TO PROJECT RISK IDENTIFICATION AND PRIORITISATION

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One of the aims of a broad ethnographic study into how the apportionment of risk influences pricing levels of contactors was to ascertain the significant risks affecting contractors in Ghana, and their impact on prices. To do this, in the context of contractors, the difference between expected and realized return on a project is the key dependent variable examined using documentary analyses and semi-structured interviews. Most work in this has focused on identifying and prioritising risks using relative importance indices generated from the analysis of questionnaire survey responses. However, this approach may be argued to constitute perceptions rather than direct measures of the project risk. Here, instead, project risk is investigated by examining two measures of the same quantity; one 'before' and one 'after' construction of a project has taken place. Risks events are identified by ascertaining the independent variables causing deviations between expected and actual rates of return. Risk impact is then measured by ascertaining additions or reductions to expected costs due to the occurrence of risk events. So far, data from eight substantially complete building projects indicates that consultants' inefficiency, payment delays, subcontractor-related problems and changes in macroeconomic factors are significant risks affecting contractors in Ghana.

Keywords: contractors, Ghana, risk, risk identification, risk impact.

INTRODUCTION

Project uncertainties create forces of risk that act in project environments to cause deviation of actual performance from the expected. Contractors may survive some levels of risk while others can result in losses and business failure. The identification of risks affecting contractors in specific construction environments and their impact on prices can help contractors to estimate a price for risk when building up prices. This study conceptualises a novel experimental approach to identify and prioritise risks affecting contractors in the Ghana construction industry.

BACKGROUND

Much of the empirical work on risk can be described as measures of perceptions rather than direct measures of the risk. Methodologically, most work has resulted from questionnaire surveys where respondents rank risks to help researchers analyse

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what can be statistically described as relative importance indices. This can be argued to be measures of perceptions (what respondents claim to be the case) rather than direct measures of the project risk (the actual losses or gains incurred). Besides, three limitations can arise from this very common approach. First, mainly the positive risks that create losses often result. Second, besides the tendency of humans to forget, respondents may seek to portray a good image of company performance. Third, the results scarcely give an idea of the consequences of the risks in monetary terms.

Risk is a fact that we all face and act upon daily. However, its measurement is difficult and highly subjective. What poses risk to one organisation may not pose risk to another. The problems of risk assessment are complex and poorly understood in practice. Contractors are often unable or unwilling to make appropriate allowances for the risk element in construction projects. While their inability may be due to nonchalance or a lack of expertise, their reluctance may be attributable also to a regard for the other factors that also affect price. This may include competition, need-for-work, perceived opportunities, and project characteristics. These factors may generally cause price of risk to be smaller than the impact of risk as risk analysis may unequal risk accountability. Risk judgments can vary per the degree and type of uncertainty involved and the amount of information available at the time of decision-making. Several definitions of risk exist in the literature, with a close link of them to formal probability theory. The commonest evaluation mechanism for one measure of project risk is to multiply its probability and its impact. The basis for evaluating the probability and the severity parameters of the concept often leads to varying risk definitions. Authors have often clashed on risk definitions. But this confusion may hinge on the often difficulty in distinguishing risk from uncertainty. For simplicity sake, some evaluation mechanisms especially in the field of finance synonymise risk with uncertainty. But technically speaking, their meanings are different as uncertain situations involve unknowability while risky situations involve knowability (Fisher and Jordan, 1996). Over the years, several questions have arisen from risk research. The key questions relate to what the natural unit of risk should be, and whether the uncertainty and severity components be multiplied directly in the sense that a small probability of a large loss is considered equivalent to a larger probability smaller loss.

Williams (1996) argues that proper consideration of project risk requires consideration of both impact and likelihood. Multiplying impact and uncertainty to "rank" risks is misleading, since the correct treatment of the risks requires both dimensions. In dealing with a single risk, there is little danger in considering the multiplied figure. However, using the fundamental theory to combine or compare non-singular risk events can be erroneous. In trying to go round this problem, the idea of plotting such risks on Probability-Impact Grids has gained popularity. However, rather than decreasing the dimensionality of the measure, some authors rather suggest an extension: Charette uses 3-dimensional graphs with independent axes he labels severity (i.e. impact), frequency (i.e. likelihood) and "predictability" (in technical terms, the extent to which the risk is aleatoric rather than epistemic). Wynne takes this distinction further, by distinguishing between risk (where the "odds" are known), uncertainty (where the odds are not known, but the main parameters may be), ignorance (where we don't know what we don't know) and indeterminacy (described as "causal chains or networks open"-so presumably implying an element of unknowability).

The variability of realised return around an expected value can be used as a quantitative description for risk (Fisher and Jordan, 1996). In the finance literature,

beta (β), has long been used as a statistical measure for unsystematic risk. Beta shows how the price of a security responds to market forces. As risk relates to profitability (Akintoye and MacLeod, 1997), the Capital Asset Pricing Model (CAPM) provides a system for linking beta to the required return of a security or portfolio. Statistically, we can use the dispersion of realised return about an expected average as a quantitative description for risk (Fisher and Jordan, 1996).

RESEARCH AIM AND OBJECTIVES

The aim is to ascertain risks affecting contractors in Ghana, and their impact on price. Specific objectives are: (1) to determine project risk levels experienced by contractors in Ghana; (2) to ascertain significant risks affecting contractors in Ghana; and (3) to ascertain impact of the risks on prices.

RESEARCH METHODOLOGY

To identify the significant risks affecting contractors in Ghana, and their impact on price, two potential strategies were identified thus:

- Controlled experiment: where substantially complete building projects would be investigated using a before-and-after experiment and documentary analyses to directly identify project risks, and their respective impacts on prices.
- Survey: where contractors would be asked using questionnaire to indicate risks they encountered on projects, and rank their significance.

Much of the empirical work in this has resulted from questionnaire surveys where researchers ask respondents to assign a 'rank' to risks listed from the literature. The significance of each risk then made to correspond to a relative importance indices calculated from the responses. Some examples in this include Liu and Bing (2005), Ghosh and Jintannapaknont (2003) and Fang et al. (2004). One can argue such measures of risk to constitute perceptions rather than direct measures of the risk.

To identify the significant risks in an underground rail project in Thailand, Ghosh and Jintannapaknont administered a questionnaire containing 59 variables (potential risk sub-factors) from a review of the literature in 17 previous studies. All 59 variables included in the questionnaire were set on a five-point scale -5¼extremely important, 4¼very important, 3¼important, 2¼somewhat important, and 1¼not important - and these scales were used to conduct factor analysis.

The questionnaires were sent to 150 respondents comprising project managers; managers; engineers; architects; and project operation officers. In all, 122 respondents consisting of 10 project managers; 13 managers; 51 engineers; 5 architects; and 43 project operation officers returned useable questionnaire. Factor analysis was the means of identifying the critical risk factors. According to importance indices, risk factors were ranked as follows: delay risk; financial and economic risk; subcontractors related risk; contractual and legal risk; design risk; force majeure risk; safety and social risk; physical risk; and operational risk. The client and project

managers were also interviewed to obtain their assessment of the risk factors but it is not clear whether their assessment agreed with the ranking.

To model contractor's markup estimation, it became necessary for Liu and Bing to identify the five most important factors affecting markup estimation, and to rate their degree of importance. The likely factors that influence markup were obtained from 5 past studies. From these studies, 52 attributes were uncovered and grouped into seven categories. The first part of the fieldwork sought to determine the most important and significant of these variables that affect markup estimation. A total of 142 survey packages were sent out on September 1, 2000. Responses were received between September 5, 2000 and October 6, 2000. Twenty-nine valid responds were received, giving a response rate of 20%. The primary section of the questionnaire was comprised of statements regarding the 52 attributes in 7 main categories that may affect markup estimation, identified in the literature.

Respondents were asked to rank the main factors from 1 to 7. The 29 respondents provided different rankings and the Hungarian method was used to ascertain the overall rankings. Respondents were also asked to indicate the importance of these attributes on a five-point Likert scale, where 1 represented a response of "very unimportant," 3 represented "moderate," and 5 stood for "very important.".

The analysis helped to derive the relative importance of the seven factors. The most important attributes under the main categories was chosen to establish the model for markup estimation. Several other studies have used similar approaches to determine the 'important' risks. But this way of prioritising risks is subject to the honest account of respondents, which may still have some distortions. Only positive risks that create losses were captured, and there is no indication of potential consequences in monetary terms.

Here, instead, we investigate direct measure of project risk by examining two measures of the same quantity; one 'before' and one 'after' construction of a project has taken place. Specifically in the context of contractors, the difference between 'the expected return' and 'the realised return' is the key measure (dependent variable) we examine through documentary analyses and interviews to identify project risks, and their respective impact on price. For the purposes of this study, we operationalise project risks as the factors (independent variables) responsible for the deviation of actual project outcome from the expected outcome. The impact of risk(s) on price will be quantified by using documentary analyses to investigate additional or reduced costs resulting from the risks.

The methodology was devised from the investigative approach used by Olken (2005) to investigate corruption levels in World Bank projects executed by local government officials in Indonesia. Using randomised controlled field experiments, he investigated missing expenditures in 608 village road projects in Indonesia. From the data on the financial reports, it was possible to calculate reported expenditures. From field surveys, it was possible for engineers to estimate the actual expenditures.

The dependent variable resulting from the difference between the two quantities on "what the villages claimed the road cost to build", and "what the engineers estimated it to actually cost to build", is the key measure of missing expenditure that was examined. The study controlled for some amount of normal loss during construction and measurement. Percent missing was also defined to be the difference between the log of the reported amounted and the log of the actual amount.

Most work in our field has focused on using questionnaire and interview surveys to obtain data on risks from respondents who may be clients, consultants, or contractors. The annotations they assign are then resolved along the lines of relative importance indices to obtain the impact. A comparison between the proposed comprehensive experimental approach and the more common survey approach should reveal that for direct measures of risk and its impact on price, the experimental research approach is more appropriate for gaining a better understanding of risks and their impact on price.

RESEARCH DESIGN AND METHODS

To identify project risks and evaluate their impact on price, it became necessary to investigate the projects themselves and not the contractors as is commonly done by most researchers.

This work draws on a small literature to formulate an approach and measurement procedure for the investigation. In specific relation to construction, The Aqua Group (1999: 14) defines risk as the possible loss (or gain) resulting from the difference between what was anticipated and what finally happened. Shah (2001) explains that the risk concept is focused on deviation from expected outcomes. Fisher and Jordan (1996) define risk as the possibility that realised returns will be less than the returns that were expected. Based on these studies, it became logical to express the variability of return around an expected average as a quantitative description for project risk.

$$Risk \approx realised\ return - expected\ return \quad (1)$$

We can therefore quantify project risk in the context of contractors by examining two measures of the same quantity - return-; one 'before' and one 'after' construction of a project has taken place. To do this, the difference between expected return (before) and actual return (after) on a project is the key measure (dependent variable) that will be examine. Project risks will be identified by investigating the forces causing deviation of actual values from the expected outcomes. The impact of each risk must show up somewhere in this difference between 'expected return' and 'actual return.' Since risk is the possibility that realised return will deviate from the expected return, we operationalise risk-level as follows:

$$Risk\text{-}level \approx [(expected\ return - realised\ return) / expected\ return] \times 100\% \quad (2)$$

A resulting positive risk-level may indicate not only the incidence of negative risks but also a greater net negative risk in some cases. The positive value may not necessarily mean the absence of some gains (positive risks) in some aspects of the project. Likewise, a resulting negative risk-level may not exclusively connote the incidence of only positive risks but also a greater net positive risk in some cases. The conventions will reverse when base costs form the basis of measurement. We can thus estimate the impact of a risk event using the following relation:

$$Impact\ of\ a\ risk\ on\ price \approx \frac{risk\ weight}{\exp ected\ price} \times 100\% \quad (3)$$

Where: risk weight is the additional or reduced costs incurred from the occurrence of the risk event; and expected price is the price quoted by the contractor in the offer/bid.

Risk weight can be quantified by using documentary analysis to ascertain the extra or reduced costs of resources incurred from the occurrence of a risk event. This method can be supplemented by in-depth interviews to probe further. In future, we can simulate the data on each risk to ascertain whether it models a specific pattern, distribution, or behaviour. Successful results can help to forecast the impact of a specific construction risk in Ghana on the price of a future project.

To control for measurement errors arising from differences in contractual capacity and varying project characteristics, only large public building projects constructed in Ghana by financial class D1 contractors were sampled. Financial class D1 contractors are the category of firms authorised by the Government of Ghana Ministry of Works and Housing to contract the largest projects because of their massive capital and resource outlay.

DATA COLLECTION

At the time of writing, data collection is still ongoing. This paper can therefore report the results obtained to date, and the plans for carrying out the rest of the work.

The data collection was done in three selected leading construction firms in Ghana, designated as sites for an ethnographic investigation into how contractors price risks.

Contractors were selected based on their suitability for the study and a willingness to allow a live study in their offices. Projects were sampled from the list of substantially complete building projects done by them in Ghana between 2000 and 2006. While obsolete data was considered undesirable, this time span was chosen to ensure a large enough sample and to help identify the impact of certain risks such as change in government and the country's economic cycles on the performance of construction projects.

The main subjects of the study were quantity surveyor and site manager in charge of projects. Quantity surveyors usually have responsibility for cost-related issues on a project while site managers have insights into actual events encountered on the project during construction.

For each project, the inquiry started with a few general questions about the project to be investigated. This was followed with specific questions on: (1) expected return on the project (or the estimated costs to build); (2) actual return on the project (or the actual costs to build); (3) factors causing a difference between the two measures (risks); and (4) contribution of each factor to the overall deviation (risk weight).

The information may have been relatively more difficult to obtain using an ordinary research strategy. However, the ethnographic approach offered some advantage. The trust created between the researcher and subjects because of the relationships built allowed access to some classified documents and information.

It became necessary to involve the company accountant as it was realised that they possess a repertoire of cost information about projects. The accountants were helpful though not designated as original subjects for the study.

In some cases, it was difficult to obtain information relating to profitability directly. This was because of poor management practices and records keeping. It was difficult for the subjects to state the amount of return they expected from the projects. But after a project is complete, they find out the amount of profit made. They price the work, allow a safe margin for profit and overheads, and then wait until the project completes to find out the level of profit made.

The contractors rarely have a systematic mechanism for delineating a cost and profit plan against which they match actual project performance to ensure a required level of return. However, they all could tell what they expected a job to actually cost. Thus, in cases where subjects could not directly relate a required level of return, data on the 'expected cost to build' and the 'actual cost to build' was used to arrive at the same result. It became possible to approximate expected profit by applying the percentage they apportion to the base estimate for profit.

Thus, two alternative ways were used to obtain the data on profitability levels. One is a direct enquiry about expected and actual profit on a project; and second is an indirect enquiry that ascertains the expected and actual costs to build. The difference between the expected and actual return is the key measure examined to answer the research questions.

There was little control for the influence of geographic factors on performance. The nature of the study made it quite difficult to obtain a representative sample from all regions in the country. The dispersion of projects is satisfactory to permit some generalisations but the primary aim is a better understanding not representativeness.

On reflection, it was wondered whether more could realistically have been be done to control for geographic influences given the nature of the investigation. The data centres on profitability which most businesses feel quite secretive about. Besides, unlike very large countries like the USA which has 4 different time zones and 11 climatic regions, Ghana is a relatively small country with uniform time and weather where physical conditions does not vary much across the regions.

RESULTS

Tables 1-8 show results of risk experiments on eight building projects in Ghana.

Of the 8 projects ranging between ¢850 million (Ghanaian cedis) and ¢6.6 billion, 2 experienced a net negative risk while 6 experienced a net positive risk. In the context of this research, negative risk implies gain to a contractor while positive risk connotes a loss.

Contrary to a widespread view, there is no clear evidence that bigger projects experience higher levels of project risk. The range of impact on price is used to judge the significance of risks as follows: low significance (0-30%), medium significance (30-70%), and high significance (70-100%).

Contract value (¢ 000)	Value of main contractor's work (¢ 000)	Expected profit - 15% of value (¢ 000)	Actual profit (¢ 000)	Risk (¢ 000)	Risk-level (%)	Risk / opportunity events	Consequence (¢ 000)		Impact of risk on price (%)
							Gain (-)	Loss (+)	
3,013,290	2,787,162	418,074	755,791	-337.72	-80.78	Appreciation in value of foreign currency	-310,203		-74.1981
						Late issuance of instructions from consultants		32,453	7.7625
						Old stock of materials	-845		-0.20212
						Variation claims	-76,303		-18.2511
						Extension of time		58,030	13.8803
						Defective work		12,305	2.9433
						Over measurement	-49,093		-11.7426
						Total risk	-436.44	102.79	-79.8078

Table 1: Project #1 risks and their impact on price

Table 2: Project #2 risks and their impact on price

Contract value (¢ 000)	Value of main contractor's work (¢ 000)	Expected profit - 10% of value (¢ 000)	Actual profit (¢ 000)	Risk (¢ 000)	Risk-level (%)	Risk / opportunity events	Consequence (¢ 000)		Impact of risk on price (%)
							Gain (-)	Loss (+)	
6,480,000	5,325,000	532,500	467,312	65.19	12.24	Delay in arrival of expatriate subcontractor to install solar cells		64,040	12.0263
						Secured nature of site ensured minimal theft	Difficult to quantify		
						Inadequate design / spec.		24,000	4.50704
						Prompt / adv. payments	-12,345		-2.3183
						Mainly locally available materials specified, with little from offshore	-8,690		-1.6319
						Total risk	-21.04	88.04	12.5831

Table 3: Project #3 risks and their impact on price

Contract value (¢ 000)	Value of main contractor's work (¢ 000)	Expected profit - 10% of value (¢ 000)	Actual profit (¢ 000)	Risk (¢ 000)	Risk-level (%)	Risk / opportunity events	Consequence (¢ 000)		Impact of risk on price (%)
							Gain (-)	Loss (+)	
1,500,000	1,300,000	130,000	69,105	60.90	46.84	Site topography was a problem		18,234	14.0262
						Inadequate design and specifications		15,435	11.8731
						Payment was very bad		32,000	24.61538
						Inflation	-33,098		-25.4600
						Materials wastage		13,000	10.0000
						Workforce strike		15,900	12.2308

						Total risk	-33.10	94.57	47.2854

Table 4: Project #4 risks and their impact on price

Contract value (¢ 000)	Value of main contractor's work (¢ 000)	Expected profit - 10% of value (¢ 000)	Actual profit (¢ 000)	Risk (¢ 000)	Risk-level (%)	Risk / opportunity events	Consequence (¢ 000)		Impact of risk on price (%)
							Gain (-)	Loss (+)	
						Payment problems		45,050	8.7632
						Price fluctuation claims	-32,009		-6.2265
						Delays due to client's direct participation in services installations		25,000	4.8631
6,590,801	5,140,800	514,080	405,756	108.32	21.07	Extensive offshore material / problems with importation, etc.		52,240	10.16184
						Inadequate design/problems with subcontractors		13,457	2.6177
						Total risk	-32.01	135.75	20.1793

Table 5: Project #5 risks and their impact on price

Contract value (¢ 000)	Value of main contractor's work (¢ 000)	Expected profit - 10% of value (¢ 000)	Actual profit (¢ 000)	Risk (¢ 000)	Risk-level (%)	Risk / opportunity events	Consequence (¢ 000)		Impact of risk on price (%)
							Gain (-)	Loss (+)	
						Many variations and conversions by client		33,988	5.3660
						Sectional completion to house residents while contract is in progress		54,004	8.5260
6,600,000	6,334,000	633,400	464,634	168.77	26.64	Design was okay. It helped us to plan the job	Difficult to quantify		
						Payment delays		45,099	7.1201
						Materials wastage		23,567	3.7207
						Poor supervision		5,005	0.7902
						Total risk	0.00	161.66	25.5231

Table 6: Project #6 risks and their impact on price

Contract value (¢ 000)	Value of main contractor's work (¢ 000)	Expected profit - 15% of value (¢ 000)	Actual profit (¢ 000)	Risk (¢ 000)	Risk-level (%)	Risk / opportunity events	Consequence (¢ 000)		Impact of risk on price (%)
							Gain (-)	Loss (+)	
						Extensive incorporation of offshore materials		42,000	9.4135
						Excess. nom. sub contrs.		32,000	7.1722
						Price fluctuations	-88,976		-19.9422
						Site topography problems		23,430	5.25138
3,006,208	2,974,458	446,169	987,896	-541.73	-121.42	Inflation	-232,527		-52.1164
						Foreign currency value	-359,071		-80.4788
						Poor coordination		12,900	2.8913
						Block plan problems		32,410	7.2641
						Total risk	-680.57	142.74	-120.5450

Table 7: Project #7 risks and their impact on price

Contract value (¢ 000)	Value of main contractor's work (¢ 000)	Expected profit - 10% of value (¢ 000)	Actual profit (¢ 000)	Risk (¢ 000)	Risk-level (%)	Risk / opportunity events	Consequence (¢ 000)		Impact of risk on price (%)
							Gain (-)	Loss (+)	
						Interference from user clients. Project was sponsored by the PTA		6,222	8.0629
805,905	771,681	77,168	60,550	16.62	21.53	Payment was very bad		40,098	51.9619
						Price fluctuation claims	-28,098		-36.41142
						Total risk	-28.10	46.32	23.6134

Table 8: Project #8 risks and their impact on price

Contract value (¢ 000)	Value of main contractor's work (¢ 000)	Expected profit - 10% of value (¢ 000)	Actual profit (¢ 000)	Risk (¢ 000)	Risk-level (%)	Risk / opportunity events	Consequence (¢ 000)		Impact of risk on price (%)
							Gain (-)	Loss (+)	
						Common use of facilities due to adjoining nature of projects	-52,234		-13.5417
						Materials stock	-44,435		-11.5198
4,301,928	3,857,272	385,727	467,932	-82.20	-21.31	Bad weather		24,500	
						Payment was very bad		42,000	10.88852
						Site topography problems		-33,098	-8.5807
						Total risk	-96.67	33.40	-22.7536

DISCUSSION

Three out of eight projects experienced a net negative risk; more profit than expected was realised. These projects were observed to be of relatively medium-size. The results in tables 1-8 also show that the biggest risks contractors in Ghana face relate to inefficiency on the part of project consultants, payment problems, and appointment of nominated subcontractors.

In-depth interviews accompanying the documentary analyses showed that many consultants in Ghana tend to fall short in their role as project team players. Working drawings generally carry mistakes and insufficient specification details. On projects, contractors may suffer from syndromes such late issuance of constructional details and instructions from consultants. In addition, formal contract administration practices are not strictly the norm in most cases. Some of the shortcomings on the part of consultants may be attributable to some traditional cultural practices and norms that engulf Ghanaian society. Unfortunately, unproductive aspects of culture and mentality have filtered through into the construction process to inhibit productivity and delivery.

Poor adherence to time schedules is generally a problem in Ghana, procrastination is commonplace, suppliers and other service providers may commonly default in meeting delivery schedules. Some consultants would also expect ‘gestures of goodwill’ from contractors when they receive interim payments. The industry ought to take a serious view of this unprofessional and unethical practice in the interest of

quality work and business survival. Payment delays is another risk which contractors in and entering Ghana ought to be mindful of when pricing. Clients of public projects consistently fail to honour interim payment within the contractually stipulated period of one month. Bureaucracy, insufficient project funds, poor attitude towards work, and a need to contact almost everyone involved in the payment process (with an 'incentive') are the main drivers of this negative phenomenon. Sometimes, projects may stall for a while (when they are not abandoned) either because of a lack of funds or political reasons. The appointment of nominated subcontractors usually takes a long time to happen on big projects. On site, their presence may sometimes delay the work if the chemistry with the main contractor is not appropriate.

In the years from 2001, the data shows that some contractors who priced jobs before the change in government experienced windfalls on projects because of significant changes in Ghana's macroeconomic position. Significant drops in the country's inflation and foreign currency exchange rate meant that discerning contractors who included a price for the rising inflation and exchange rate of foreign currency in their bids started to make gains when economic policies of the new government started to lower inflation, interest rates and exchange rates significantly. We can see that in the absence of macroeconomic risks, contractors in Ghana incur an average risk of 26% in the execution of projects because of risks relating to consultants' efficiency, delayed appointment of nominated subcontractors, and payment problems.

Steps taken to deal with these risks can promote commerce and perhaps lower construction costs to clients. Problems relating to the extensive incorporation of offshore materials in designs and specifications are risks contractors also ought to consider due to import regulations. Other identified risks that relate to the management of internal resources include materials wastage, workforce strikes, and poor supervision. Only three out of eight projects experienced profitability levels above what was expected. All other five projects ended up more costly than the bidders actually estimated. How then are contractors managing to cope and survive the effects of risks in the Ghanaian construction industry? Preliminary discussions with some contractors showed that they try to exploit opportunities during construction to balance losses.

CONCLUSIONS

An alternative rigorous method has been devised in this study to help identify the risks affecting contractors in Ghana, and their impact on prices. The study to date shows that consultants' inefficiency, payment problems, and excessive delays in appointment of nominated sub contractors are the significant risks. Despite the heavy impact of these risks on prices, contractors are still able to cope because of their ability to exploit opportunities such as minimal enforcement of construction industry laws and regulations, stock piling of resources, workers' due and entitlements, and inefficiency in the performance of consultants.

The investigative approach proved useful to the answering of research questions despite the belabouring amount of work involved. Poor records keeping and sensitive nature of the data required were some of the challenges encountered. The primary concern has been for a better understanding of risks and their impact on prices, and not necessarily generalisations and representativeness. The results can help

contractors in and entering Ghana to price risks into bids. Further research on the approach is recommended.

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