THE PRICE OF RISK IN CONSTRUCTION PROJECTS

Samuel Laryea[1] and Will Hughes[2]

[1]*Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana*
[2]*School of Construction Management and Engineering, University of Reading, PO Box 219, Reading, RG6 6AW, UK*

Construction projects are risky. However, in practice, contractors may be unable or unwilling to make appropriate allowances for the risk. Formal risk models that contractors can incorporate into the bidding process have proliferated in recent years but they are not used in practice. Introducing more models may, therefore, not necessarily help. A better understanding is needed of how contractors arrive at a price, and how that price is influenced by the apportionment of risk. This question is the starting point for an ethnographic investigation into how contractors price risks. The purpose is to develop a model for assessing risk and opportunity in construction projects for the purpose of contingency allocation in a risk and reward sense. As risks can be spread, the price of building up a contingency will generally be smaller than the impact of a risk. Price of risk is smaller than the impact of risk.

Keywords: contingency, contractors, risk apportionment, risk assessment, tendering.

INTRODUCTION

Construction projects are affected by many risks that must be assessed and accounted for in tenders. Otherwise, a construction enterprise may suffer a tremendous loss and eventually fail. In developing a fuzzy model for contractor project risks contingency allocation, Tah *et al* (1993:282) noted that some of the risks are related to management of internal resources whereas others are prevalent in the external environment of the project. Common risks construction contractors face include weather, unexpected job conditions, personnel problems, errors in cost estimating and scheduling, delays, financial difficulties, strikes, faulty materials, faulty workmanship, operational problems, inadequate plans and specifications, and disaster. Contractors can respond to the price of risk before a construction project or after. They can choose to forecast the price of risk based on all information available at tender stage and account for it, or they can be indifferent and count the price of risk after a contract. Many formal and analytical risk models have proliferated in recent years but research in the UK and USA construction industry by Akintoye and MacLeod (1997:36) and Ahmed *et al* (2002:7) respectively explain reasons why they have low take-up in practice.

BACKGROUND

Contractors face many risks in executing construction projects. These have to be effectively evaluated, followed by sound decisions based on the evaluation, and

[1] salaryea@yahoo.com

Laryea, S and Hughes, W (2006) The price of risk in construction projects. *In:* Boyd, D (Ed) *Procs 22nd Annual ARCOM Conference,* 4-6 September 2006, Birmingham, UK, Association of Researchers in Construction Management, 553-561.

appropriate action taken as a result of these decisions. If the monetary loss resulting from risk events is not considered or is underestimated due to associated uncertainties, a construction enterprise may suffer a tremendous loss and eventually fail (Paek *et al*, 1993:743).

In the UK, research carried out by Hughes *et al* (1998:22-29) to identify forms of financial protection against risks in the UK construction industry found that in comparison to other industries, risk of insolvency is higher in the construction industry. This is, however, very marginal during boom periods. The need for financial protection against the potential extra expense brought about by insolvency and/or poor performance was exacerbated by two features of the UK construction industry: the low capitalization of construction companies and the high frequency of insolvencies within the industry.

The unique nature of construction industry, construction projects, and how work is organised, makes contracting different from other industries. This is mainly as a result of peculiar factors relating to economic, contractual, political and physical environments within which products are manufactured. They include: necessity to price product before production, competitive tendering, low fixed-capital requirements, preliminary expenses, delays to cash-inflows, tendency to operate with too low a working capital, seasonal effects, fluctuations and their effects, Government intervention, activity related to development, uncertain ground conditions, unpredictable weather, no performance liability or long-term guarantees, etc (Calvert *et al*, 1995:124; Oxford Encyclopaedia of Economic History, 2003:1:508-510). Construction projects are complex, have a long production cycle, involve input of many participants, and must meet many standards and statutory regulations (Kwakye, 1997). Contractors are not poor at managing risks as the literature generally presents it. For example, research conducted through literature review and preliminary discussion with construction contractors in Mozambique by Baloi and Price (2003:262) aimed at developing a fuzzy decision framework for contractors to handle global risk factors affecting construction cost performance at a project level reported that: 'Unfortunately, many contractors are unfamiliar with these risk factors and do not have the experience and knowledge to manage them effectively. As a consequence, conflicts, poor quality, late completion, poor cost performance and business failures are commonplace in the construction industry.' Another questionnaire and interview research conducted on by Ahmed *et al* (2002:4) in the USA to find out risk management practices of medium-to-large scale general contractors in Florida state (34 contractors) in comparison to three other states; Georgia (28), North Carolina (34), Illinois (30), and New York (26) argued that: 'construction is a highly risk-prone industry with not a very good track record of coping with risks.' These assertions may not hold generally.

Since the early part of the 19th century, contractors have used various ways to survive risks in construction industry. Most contactors resorted to speculative house building in the 19th and 20th centuries to sustain labour force and business costs through the peaks and troughs of contracted work. In modern times, there is a growing tendency for contractors to use their positive cash flows to invest in projects, rather than house building. Most recently, successful contractors are diversifying into businesses whose cycles counteract those of construction (Hughes and Hillebrandt, 2003). Contractors are minimising risk by declining work perceived as too risky, subcontracting large portions of their work to others, and apportioning risk in wage structures. In essence, they are passing on risk to others.

Traditionally, contractors use intuition and experience to judge allowances to cover the risks. Conceptual research, Tah *et al* (1993:284), introducing a fuzzy set model for a contractor's project risks contingency allocation suggests such decisions are influenced mainly by the estimator's perception of risks and management's view of the future and their desire to avoid an overrun situation. In contemporary times, classical and conceptual risk models that contractors can use when bidding have proliferated. But they are unused in practice. Reasons were found by Akintoye and MacLeod (1997:36) in a questionnaire survey of 30 general contractors in the UK construction industry to find out how they perform risk analysis and management in construction projects. Non-empirical research proposing a construction risk management system to substitute the traditional intuitive approach of contractors' risk assessment by Al-Bahar and Crandall (1990:534) defines risk as: 'exposure to the chances of occurrences of events adversely or favourably affecting project objectives as a consequence of uncertainty.' The Aqua Group (1999:14) conceptualise it as: 'the possible loss resulting from the difference between what was anticipated and what finally happened.' Essentially, risk results from uncertainty (Loosemore *at al*, 2006:8); construction projects are surrounded by uncertainties. It is, therefore, important for contractors and contractual parties to properly recognise risk and account for it as it forms the basis of almost everything in construction - pricing policies, contract strategies, procurement routes, and health and safety. Price is the sum of overhead and direct costs for material, labour, and plant (Ling and Liu, 2005:391).

Contractors normally plan their tenders to satisfy a duple constraint objective of offering the most attractive price, whilst minimising their risks and liabilities under a potential contract (Marsh, 2000:53). However, getting work is the overriding factor, and they employ several means to respond to risks not covered by the contract, bonds, or insurance. Contractors systematically add a premium to their bids to account for both riskiness of a project and their lack of enthusiasm to do a job when they do not need the work. This was found by Neufville and King (1991:668) when they performed two-way empirical investigation on 30 contractors in the USA to identify how risk and need for work influences behaviour of bidders. The study also found that, for contractors, risk premium can be apportioned as high as 3% of the total project cost. The risk premium covers both the transactional costs of organising the market and reasonable profit margins. Because of competition factor, there is only an extent to which contingencies can be apportioned in markup. Markup, sum of contingencies and profit, is calculated as a percentage of the sum of overhead and direct costs for material, labour, and plant. From total of 142 postal questionnaires sent and received from contractors in the USA from 1 September to 6 October 2000 to obtain feedback on the importance of factors influencing markup, the aggregate of 29 responses ranked the factors as: project characteristics, project documents, company characteristics, bidding situation, economic situation, and client characteristics (Ling and Liu, 2005:391). Contractor contingency is the estimated value of the extraordinary risks that will be encountered in a project. Extraordinary risks are those project risks that are not covered by bonds, insurance or the contract. Although small in sample size, interview studies of 12 small to medium contractors in the USA to find out issues relating to the extent to which they apportion and assume risk in their contracts concluded that in times when competition is high, contractors do not include contingency in tenders (Smith and Bohn, 1999:107). A high number of bidders and low workload will guarantee almost no contingency in the bid. They identify this as a factor most modelling techniques and table of risk factors do not consider as an

overriding concern. Where contingencies were used, eight factors that influenced it were identified as: workload, contract size, project complexity, number of bidders, owner's reputation, bidder mentality, clarity of contract documents, and time frame for bidding (Smith and Bohn, 1999:106). The contractors had no knowledge of the formal risk modelling techniques. They mostly use a percentage of the total cost approach based on their intuition and previous contract knowledge to determine the contingency allowance (107).

Generally, the literature is rampant in its record that contractors mainly use 'intuition', 'gut-feeling', and 'expert skill' based on experience to assess risks. Because such approaches are unsystematic, some, for instance, Baloi and Price (2003:262) and Ahmed *et al* (2002:4) have argued that contractors are ineffective at managing risks. But this may not be true. Although contractors may be unable to analytically explain the science or psychology of their risk response mechanisms, the lump sum and fixed percentage amounts they apportion is backed by wisdom and intelligence that this study hopes to learn and formalise by way of ethnographic research to improve the practice of contingency allocation. Years of experience in contracting provide them an intuitive understanding of the industry's economics that they apply to adjust resources based on perceived risks and opportunities.

PROBLEM STATEMENT

The problem under investigation is: how do construction contractors assess and price risks when tendering? In recent years, many formal and analytical risk models that contractors can incorporate into the bidding process have proliferated in uniformity with the growing Project Risk Analysis and Management discipline. However, they are unemployed in practice due to reasons found in Akintoye and MacLeod (1997:36), Smith and Bohn (1999:107), and Ahmed *et al* (2002:7). Introducing more models correspondingly may therefore not necessarily help. The need is for a better understanding of how contractors arrive at a price, and how that price is influenced by the apportionment of risk. Contractors have since long had their own customary ways of responding to risks that we can learn and somewhat formalise into practical models for project risk assessment and pricing.

AIMS AND OBJECTIVES

The overall aim of the research is to investigate how construction contactors assess and price risks in construction projects to help develop a contingency approximation model for pricing risk and opportunity in construction projects. Specific objectives of the research are: (1) to investigate the effect of risk on pricing (how risk relates to pricing); (2) to ascertain how contractors account (assess and price) for risk at tender stage; and (3) to ascertain the impact of significant risks on tender prices. This paper presents findings of a preliminary study of selected contractors in the UK construction industry prior to the full-scale ethnographic investigation.

RESEARCH APPROACH

How do contractors assess and price risks? A systematic approach to answering such a complex research question poses obvious ontological, epistemological, and methodological challenges. In the first place, risk perception varies greatly. This is a major ontological concern. Besides, what will be the indicator that a contractor is pricing a risk? How would the researcher measure how contractors respond to it?

What is the researcher's meaning of the concept 'risk' and how would it be known whether or not it is present? In other words, what is the researcher's theory of risk? These are major epistemological issues that need to be considered from both positivist and interpretivist standpoints. How to measure impact of a risk on price is another major methodological concern. By and large, these represent obvious philosophical challenges the researcher hopes to overcome through broad preliminary studies and extensive review of relevant literature on theory and techniques suitable for answering the research question.

Preliminary studies were done to help gain a better understanding of the subject through extensive literature review, formal and informal interviews with contractors, practitioners and experts in the UK construction industry.

As a strategy, ethnographic research will be conducted for firsthand observation of how contractors arrive at price, including how they respond to risk. Earlier work has been done by cross-sectional surveys where researchers recorded what respondents claimed to be doing which may not necessarily be the same as what is actually the case. The ethnographic approach will help provide a detailed and permanent account of the culture of how contractors assess and price risks. Content analysis will be used to analyse the qualitative data whereas quantitative data will be analysed by appropriate statistical techniques. The results will be integrated to develop a predictive model for pricing risks and opportunities in order to improve the practice of contingency allocation.

RESEARCH DESIGN

Selected contractors, experts and practitioners in the UK construction industry were interviewed between 7 March and 26 May 2006 in a preliminary investigation meant to review a series of questions developed during the critical literature review and gain a better understanding of the subject area. Amongst potential strategies, ethnography was surveyed as the comprehensive strategy needed for capturing pricing activities of contractors, including how they respond to risk. Ethnographic research design is a hybrid approach in which the field worker is present in two agencies, as data gatherer and as a person involved in activities directed towards other objectives (Silverman, 1997:10).

To help formulate an appropriate and reliable ethnographic design for the full investigation, one ethnographic study will be done in a construction organisation to pre-test the proposed research design. Companies will be selected for the research based on appropriateness for the investigation and willingness to support the research. This phase of the study is envisaged to help appreciate, in advance, problems such as access and role of the researcher that will be encountered as this kind of research strategy is novel in fields related to the construction industry. The experience gained will be used to modify the proposed design for a successful full ethnographic investigation into the research question. Bloor's (1978) approach to analytic induction will form the basis of the ethnographic research design: access will be gained to the phenomenon of interest; the phenomenon whose variation is to be explained will be defined; a provisional list of case features common to each identified category will be created; case features shared by more than one category will be identified; and theoretical explanations of variance in the phenomenon already tested through observation will be presented.

Key requirements of ethnographic research outlined in Denscombe (2003:84-94), Gill and Johnson (2002) and Silverman (1997:8-23) will guide the design of the investigation. The research design will ensure that: considerable time is spent on empirical observation to allow for a journey of discovery; data is obtained within the routine and normal aspects of everyday life; findings reflect how estimators and contractors being studied understand things; the researcher remains open to elements of social, cultural and psychological aspects of contractor organisations; and the phenomena observed in the field is grounded, and describes what was observed rather than crafted construction or rhetoric of the ethnographer's own experiences.

In ethnographic research, the purpose is to produce detailed pictures of events or cultures – descriptions which stand on their own right - without the need to worry about how representative the situation is or what the broader implications might be in terms of other events or cultures. The crucial factor is the depth and detail of description, the accuracy of what it portrays and insights it offers to readers about the situation being studied (Denscombe, 2003:86).

PRELIMINARY DATA COLLECTION AND ANALYSIS

All preliminary data was collected personally from selected contractors, experts, and project managers in the UK construction industry through interviews and documentary evidence, between 7 March 2006 and 26 May 2006. The interviews were designed to elicit views for better understanding of the subject area, and methods appropriate for achievement of the research objectives. The interviews mainly involved open discussion of risk assessment and pricing practices in construction, followed by a series of specific queries on particular issues that had been developed from the literature review and informal discussions. In all, 5 selected main contractors, 3 project managers, and 7 experts were interviewed.

CONTRACTORS' RISK ASSESSMENT AND PRICING

Some contractors indicated that they start risk management long before pricing. They decline or accept tenders based on how risky they perceive a project. Generally, all contractors interviewed conceded that intuition and gut-feeling underlie their risk response mechanisms. They rely on the experience and skill of their estimators before a decision is taken at director's level on final tender price.

In one company, a formalised kind of system is used. When tender documents are received, a risk workshop, comprising relevant personnel for the proposed project, is held to identify all potential risks. The risks are then assessed based on an in-house spreadsheet model that helps to price the risk as a contingency allowance based on effect / severity and probability values assigned by the team based on experience and intuition. To evaluate the risks, they use what seems to be an application of the fundamental theory on risk equals probability times impact to designate some of the risks as 'green', 'amber', and 'red'. Risks are designated as green, amber, and red when their 'trigger levels'; the multiplied product of probability and maximum severity values lie within 0-6, 6-12, and 12 and above respectively. They identify options for mitigation response, designate risks owners, and assign individual risk managers to risks. A contingency allowance is then approximated based on a 'likely cost', 'pessimistic cost' and 'optimistic cost' of the assessed risk.

IMPACT OF RISKS ON PRICES

Table 1: Impact of risks on price of a maintenance project

Estimated Direct Cost	Actual Cost-to-Contractor	Deviation from Expected Outcome	Risk-Level* (Percentage)	Risk / Opportunity Events	Impact on Tender Price	Percentage Contribution
£1,430,000	£1,630,000	-£200,000	13.99	Additional Planning / Regulating	£80,000	40
				Additional Excavation and fill to embankments	£50,000	25
				Various Additional Works (SI's, VO's, CVI's	£40,000	20
				Extension of Time / Prolongation	£30,000	15
				TOTAL RISK	£200,000	100%

*Risk-level = (Estimated cost – Actual cost)/Estimated cost x 100%

Main source of risks was major variations due to incorrect levels provided by clients

Table 2: Impact of risks on price of another project

Estimated Direct Cost	Actual Cost-to-Contractor	Deviation from Expected Outcome	Risk-Level* (Percentage)	Risk / Opportunity Events	Impact on Tender Price	Percentage Contribution
£257,000	£300,000	-£43,000	16.73	Landscaping work to lorry park	£22,000	51.16
				Traffic management	£5,000	11.63
				Tree pits	£3,000	6.98
				Fibre screed jointing repairs	£3,000	6.98
				Out of normal working hours	£3,000	6.98
				Various other SI's, VO', CVI's	£7,000	16.28
				TOTAL RISK	£43,000	100%

*Risk-level = (Estimated cost – Actual cost)/Estimated cost x 100%

Main source of risk was from additional works

From Table 1, the total negative risk experienced in the £1.43m project was caused by four main factors of which additional planning and regulating was the most significant risk. The expected project cost was exceeded £200,000; almost 14% over the expected cost value. Hence, either the level of profit targeted was affected by this much or a loss of this magnitude was suffered. In Table 2, the £257,000 project experienced a negative risk of £43,000; representing almost 17% over the expected value.

IMPACT OF RISK ANALYSIS ON TENDERS

All contractors interviewed were quick to point out that risk has a significant influence on pricing. Although many of them could not be exact about impact of risk analysis on their tenders due to unsystematic apportionment of risk, one contractor estimated it as high as 25% in special cases, and as low as 5% in normal cases. The others mainly ranged it between 5% and 15% of the tender estimate. Judging from how they presented the case, it was doubtful if this is actually true. What appeared to be

significant was that most times, risk analysis allowances often failed to make the final tender figure. The estimators usually identify and assess the risks in one way or the other. When they priced these identified risks and similar contingencies, directors amend the net tender price in order to enhance their chances of winning the job. In some cases therefore, risk analysis had no significant impact on tenders at all.

DISCUSSION

Contractors are becoming more risk conscious. They employ various strategies to minimize exposure to risk and enhance the chances of gain. Subcontracting is one major way main contractors are using to minimize risk. They also perform more detailed studies of the client's tender documents to ensure that they have a chance of reasonable profit under the conditions of contract before submitting a competitive bid. When they realize that the client's tender is 'rubbish' as one Operations Manager put it, i.e. contains huge flaws in the quantities of the client's estimators, they take advantage of it to price higher for quantities of work that although little in the Bill of Quantities, are envisaged to vary widely during construction compared to other areas of unlikely variations where they price lower to stay competitive. Most of the contractors interviewed do this and clients should ensure more accurate estimation of quantities by their surveyors to avoid price shocks on submission of valuations and loss of value. This strategy is mainly meant to present a more competitive bid that may seem competitive at bidding yet privately assuring the contractor of higher profit margins when areas of likely variations finally occur on the job. Not all contractors interviewed are leaving risk assessment and pricing to chance and experience of their estimators. Some more enlightened ones employ some formalized approaches to risk assessment and pricing. The structured system helps more to bring risks to the fore for more effective management. In the words of a manager of the head of operations of one of the companies surveyed, their risk assessment and pricing was done mainly by 'intuition' and 'gut-feeling'. He explained that risk assessment had a very significant impact on their pricing. Yet this was left to the discretion of the estimators. They have to make the allowances for risk based on their perception and experience, and explain it to the Directors for acceptance or otherwise before the final tender figure is reached. However unsystematic this appeared at the company level, some estimators had developed a somewhat formal approach at their own level. Most contractors interviewed based their allowances on intuitive judgment based on speculative forecasts based on experience. However, the practice is improving. One of them had developed a sort of spreadsheet-based technique for valuing the contingency allowance based on his experience about labour productivity of the company's employees. He then adjusted these factors to determine suitable allowances for risk. This finding was similar to that found by Neufville and King (1991:665). At the aggregate level, the main concern is getting work to keep the company going. Hence, the directors sometimes fail to account for risk in final tender price. Contractors in general do not use the formal models of PRAM but could certainly benefit from it.

CONCLUSION

Preliminary research has been carried out in preparation for a full ethnographic investigation into how contractors assess and price risks. The practice of traditional direct intuitive judgment approach towards risk management is improving. Risk analysis has significant impact on tenders. Tender prices of contractors are affected significantly by risks. Risk analysis is not always accounted for in tenders as a result

of need for work. The incorporation of risk and opportunity allowances into a tender price is a complex process that all contractors grapple with yet, truly oversimplified by the formal models of Project Risk Analysis and Management that have abounded.

REFERENCES

Akintoye, A.S. and MacLeod, J.M. (1997) Risk analysis and management in construction. *International Journal of Project Management*. **15**(1), 31-38.

Al-Bahar, J.F. and Crandall, K.C. (1990) Systematic risk management approach for construction projects. Journal of Construction Engineering and Management, ASCE. **116**(3), 533-546.

Ahmed, S.M., Azhar, S. and Ahmad, I. (2002) Evaluation of Florida General Contractor's risk management practices. Journal of Construction Engineering, CIB. **17**(1), 4-11.

Baloi, D. and Price, A.D.F. (2003) Modelling global risk factors affecting construction cost performance. International Journal of Project Management. **21**(4), 261-269.

Bloor, M. (1978) On the analysis of observational data: a discussion on the worth and uses of inductive techniques and respondent validation. Sociology. **12**, 542-545.

Calvert, R.E., Bailey, G. and Coles, D. (1995) *Introduction to building management.* 6ed. Oxford: Butterworth Heinemann.

Denscombe, M. (2003) *The good research guide for small scale projects*. 2ed. Maidenhead: Open University Press.

Gill, J. and Johnson, P. (2002) *Research methods for managers*. 3ed. London: Sage

Hughes, W.P. (1998) *Financial protection in the UK building industry: bonds, retentions and guarantees*. London: Spon.

Kwakye, A.A. (1997) Construction project administration in practice. London: Longmann.

Liu, M. and Ling, Y. (2005) Modelling a contractor's markup estimation. *Journal of Construction Engineering and Management, ASCE.* **131**(4), 391-399.

Loosemore, M., Raftery, J., Reilly, C., and Higgon, D. (2006) *Risk management in projects*. 2ed. London: Taylor and Francis.

Marsh, P.D.V. (2000) Contracting for engineering and construction projects. 2ed. Hampshire: Gower Publishing.

Neufville, R. and King, D. (1991) Risk and need for work premiums in contractor bidding. Journal of Construction Engineering and Management, ASCE. **117**(4), 659-673.

Paek, J.H., Lee, Y.W. and Ock, J.H. (1993) Pricing construction risk: fuzzy set application. Journal of Construction Engineering and Management, ASCE. **119**(4), 743-756.

Silverman, D. (1997) *Qualitative research: theory, method, and practice*. London: Sage

Smith, G.R. and Bohn, M.C. (1999) Small to medium contractor contingency and assumption of risk. *Journal of Construction Engineering and Management, ASCE*. **125**(2), 101-108.

Tah, J.H.M., Thorpe, A. and McCaffer, R. (1993) Contractor project risks contingency allocation using linguistic approximation. *Journal of Computing Systems in Engineering.* **4**(2-3), 281–293.

The Aqua Group (1999) Tenders and contracts for building. 3ed. London: Blackwell science.

Hughes, W.P. and Hillebrandt, P.M. (2003) Construction industry: historical overview and technological change. *In:* Mokyr, Joel (ed.-in.chief) *The Oxford Encyclopedia of Economic History*, Oxford: Oxford University Press, Vol 1, 504-512.