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PROFILING AND MITIGATING RISKS IN CONSTRUCTION CONTRACTS

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ABSTRACT

Multiple risks are present in all construction contracts. During the bid process the contractor has to identify the different risk factors inherent in each prospective project. The identifiable risk factors will have differing impacts on profit margins and contingencies allowed for in the tender bids. Currently in New Zealand, there is little or no information on how to profile and respond appropriately to construction contract risks. This could lead to contractors overcompensating for risks or leaving themselves dangerously exposed through inadequate response. This study aimed to establish the leading contractual risk factors in the New Zealand construction industry, their risk profiles and mitigating measures. The research was based on qualitative and quantitative information garnered from practitioners in the New Zealand construction industry. Descriptive statistics and multi-attribute techniques were used in the data analysis. Results highlighted 21 risk factors which were segregated into 6 broad categories in diminishing levels of significance as follows: Site conditions, main contractor, pricing, subcontractor, external and client- related risks. Putting tags and conditions to risky price items or aspects of the tender bids, and transferring the risks onto other parties were analysed as the two most effective out of the 5 key risk mitigation measures identified in the study. Being cautious of the priority risk factors and application of the identified most effective risk mitigation measures could guide contractors and the project team to more appropriately budget for and respond to risks thereby ensuring more satisfactory project outcomes.

Keywords: Construction contracts, construction risks, risk management, risk profiling, risk response deployment, tendering risks.

INTRODUCTION

Risk or uncertainty is a detrimental reality in the construction industry. Not appreciating risk and accounting for it can be very costly to all stakeholders involved in risky decision making in relation to construction contracts.

While it is true that risk is present in every undertaking, the construction industry itself is especially risk prone due to the fact that construction projects are one off projects with many

features that make them unique to most industries. Lengthy construction periods and time pressures, complexity and a very competitive market give rise to so many risks which must be responded to (Zou et al., 2007). Globally, extensive research has been carried out into construction risks, and several risk factors have been identified (Yean Yng Ling & Liu, 2005; Marcus & David, 2012; Rowe, 1977). However, little research has been carried out on construction risks in the New Zealand context (Mbachu, 2011).

Despite it being risk endemic the construction industry has a poor reputation for structured and formalised risk analysis when compared with other industries such as insurance or finance (Laryea & Hughes, 2008). This shows that there is a crucial need for the industry and in particular contractors to have an appreciation of the risks they face and the underpinning factors through having a framework in place for risk analysis and response deployment. The risk of failure in construction businesses suggests that construction companies are not successfully accounting and allowing for risk (Oyewobi, Ibrahim, & Ganiyu, 2012). Within New Zealand we have not been immune to this either, with high profile business failures such as the recent liquidation of Mainzeal.

Contractors have several tools at their disposal for allowing for and managing the risks they may face. Much of this is done through the application of contingency margins to effectively price out the risk. Smith & Bohn (1999) posit a concise way to think of the contractor's contingency as their estimated value of the extraordinary risks they will encounter in a project. Other approaches at the contractor's disposal include avoiding the risk or transferring the risk to other stakeholders involved in the project. There are several models for pricing risks; however several empirical studies (Laryea & Hughes, 2011; Mochtar & Arditi, 2001) have shown that they are rarely used in practice. Instead the industry appears to largely rely on experience and intuition (Larim et al., 2012).

This study aimed to fill a knowledge gap in the literature by examining and ascertaining the specific risk factors experienced in the New Zealand Construction industry. The study also examined how New Zealand contractors are dealing with the identified risks and the impact of the risks on their businesses. Risk profiles of survey participants in the New Zealand construction sector were evaluated in terms of the frequency of occurrence and impact of the identified risk factors to their profit margins. The overall aim is to develop a risk response deployment framework for profiling, pricing and responding to risks present in construction contracts. Providing a clear and concise risk response approach for New Zealand would be of a great benefit to contractors within New Zealand.

LITERATURE REVIEW

The following subsections will focus on highlighting the key terms and definitions associated with contract tendering, risk in context, risk analysis, risk response deployment method and pricing of contractual risks. Gaps in the existing literature are identified at the end, with an indication of how this study will contribute to narrowing the gaps.

Tendering in construction

Construction industry in most countries is an extremely competitive industry typified with high risks and low profit margins when compared with other sectors of the economy. (Mochtar & Arditi, 2001). Tendering is the popular means by which a company secures work and the price they put forward in the tender is the only instrument for earning revenue. This sets the backdrop as to why it is so important to consider risks in construction contracts as the optimum mark-up needs to be achieved to increase chances of being successful.

Since the lowest price is generally the one accepted in the competitive tender process, especially for government contracts (Nutakor, 2007), the onus is then on the prospective contractor to deliver as low a bid as possible. This consequently shapes the treatment of risk and attitude to how they price it. With the above in mind when tendering it is critical to identify the optimum mark-up for the project as this increases the contractor's chances of being successful and winning the tender (Yean Yng Ling & Liu, 2005).

Defining 'risk'

A multitude of definitions for risk exists; however they all make the same fundamental point that risk is an unwanted effect or uncertainty that can affect project objectives. Risk is inherent in all construction projects and as such it can never be fully eliminated, although as a best case it can be managed effectively to limit and mitigate the impacts on expected project outcomes (Nieto-Morote & Ruz-Vila, 2011). Risk can be seen as the potential for unwanted or negative consequences of an event or activity (Rowe, 1977). The Australia and New Zealand standard (AS/NZS) 31000 (Australia, 2009) defines risk as the effect of uncertainty on objectives.

In the context of this study, risk and uncertainty are synonymous; each reflects the opportunity that is also embodied in uncertainty.

Benefits of risk analysis

Risk analysis is conducted to show what will happen if the project does not proceed according to plan. It acts as a warning system to alert the organisation to risks and uncertainties in the project's external landscape. It therefore assists in capturing all feasible options and helps to analyse various outcomes of any decision (Ahmet & Önder, 2003).

It has to be shown that there are benefits for undertaking risk analysis. Existing research shows that there is a relationship between successful risk identification and project success. For instance, Baloi & Price (2003) conclude that there is a logical relationship between adopting effective risk management strategies and project success since risks are assessed based on their potential impact on the objectives of the project.

Risk response deployment methods

Many formal models exist for assessing and pricing of project risks at the tender stage. Laryea & Hughes (2008) identify sixty models in their study on the pricing of risks in tender bids. These range from experience-based rule of thumb to formalised stochastic processes.

For the most part practitioners rely on their experience and intuition to allow for risks during the tendering phase. More flexible models have been suggested by Laryea & Hughes (2011) and Mbachu (2011), which are more practicable and simple to use by contractors. Additionally a straight margin on risk approach will often not work as contractors need to price their bids below this level to ensure they remain competitive.

Popular contractual risk factors

Several studies have focused on risk identification in the construction sector (Marcus & David, 2012). Ling (2005) identify five risk factors that seemed to be common cross the globe:

- Risks due to the nature of the work.
- Risks due to current workload / the desire of the company to have the project.
- Risks due to the need for work.
- Risks due to reliability or unreliability of a company's pricing approach.
- Risks based on the perceived competitiveness of other bids.

Pricing risks in construction tenders

Most risk pricing models in existence operate on the basis of applying a contingency margin once the level of risk has been identified. There is little research to support that there is systematic pricing of risks in the construction industry (Laryea & Hughes, 2008). In practice there is often a systematic undercutting of the identified risk so that contractors could stay competitive (Mbachu, 2011). The models for pricing risks generally do not take into account the realities of the market and specific needs of the contractor such as the desire to win the job or outbid competitors, or the expectation of more profitable future contracts following successful completion of the job at hand (Mbachu, 2011).

Existing knowledge gap

There is little research on the subject matter of contractual tendering risks in New Zealand. Also there is a lack of practical risk response deployment method that contractors could use. The literature is therefore lacking in terms of the knowledge of how contractors move from their understanding of risk factors to then setting a price (Laryea & Hughes, 2011). According to Smith & Bohn (1999), most risk and contingency studies has tended to focus on purely theoretical and analytical models for determining the level of risks in a contract. These models generally describe a set-loading of a fixed percentage contingency to cover risks. This study aimed to establish what the leading contractual risk factors are in the New Zealand construction industry, their risk profiles, and holistic risk response deployment strategies for addressing the risks.

RESEARCH OBJECTIVES

The key objectives of this study are as follows.

1. To identify key risks that contractors in New Zealand construction industry encounter when pricing tenders.

2. To investigate the impact of the identified risk factors on contractor's profit margins and their occurrence frequencies.

3. To evaluate appropriate risk response deployment measures for addressing the identified risks. This involved undertaking a study of frequency and scale of risk negating measures.

RESEARCH METHOD

Research approach

A descriptive research method was adopted as observation technique (through opinion survey) was used as the primary data collection method (Mbachu, 2011). This involved questionnaire survey of stakeholders in the industry including contractors, quantity surveyors and project managers. A qualitative scoping study was first conducted amongst convenience samples of the stakeholders through purposive sampling. This helped to identify risk factors and mitigation measures specific to the New Zealand context. In the questionnaire survey, respondents were then asked to rate the relative levels of impact of the identified risk factors as well as relative levels of effectiveness of the identified risk mitigation measures.

Scope and limitations

The target population consisted of consultants, subcontractors and main contractors. These industry role players came from different sectors of the industry including commercial construction, interiors, civil construction and residential works within New Zealand.

Limitations of the study that were encountered included limited direct access to contractors, subcontractors and consultants. There are of course other stakeholders that affect risk but this study chose to focus on those groups described above. The respondents were largely Wellington based. Poor response rate has always been an issue in the construction industry, which limited the intention to have representative views from the various sampling frames.

Data sources

It was originally intended to utilise membership directories of the New Zealand Institute of Quantity Surveyors (NZIQS) (for quantity surveyors), New Zealand Institute of Building (NZIOB) (for consultants), the Registered Master Builders Federation (RMBF), and Specialist Trades Contractors Federation of New Zealand (STCFNZ) (for contractors and subcontractors, respectively). However due to difficulties inherent in obtaining membership directories from organisations due to privacy concerns, the surveys were administered through email circulars dispatched by the secretariats of the various trade and professional organisations.

Data analysis

Descriptive statistics were used in the data analysis. This involved computation of statistical measures of central tendency - mean, median and mode – as well as measures of dispersion – variance and standard deviation. This helped to understand the mean ratings for each group and the variances in opinions. The SPSS package was also used to carry out Spearman Rank correlations across multiple variables.

Relative Significance Index (RSI) values computed from the data helped to rank-order the factors according to their risk levels. Overall, the research data gathering and analysis drew from the recommendations of authors such as Mbachu (2011) and Elhag et al. (2005). Elhag et al. (2005) present a mathetical model for computing the RSI as shown in Equation 1.

$$\mathrm{SI} = \left(\sum_{i=1}^{5} w_i \times f_i\right) \times \frac{100\%}{n} \qquad (1)$$

Where:

i : Represents the ratings 1-5 from the questionnaire

f_i : The frequency of responses

n : The number of total responses

w_i : The weight for each rating (ranging from 1 to 5 on a 5-point Likert rating scale).

RESULTS AND DISCUSSIONS

Survey responses

One hundred and eighteen responses were received by the cut-off date out of which only thirty six were found usable. This represented a usable response rate of 31%. Discarded responses did not meet the quality criteria set for feedback. This included responses from inexperienced people (years of experience less than 2 years, including interns/ trainees (30%), incomplete surveys (20%) and responses from people that do not have the experience and expertise to make meaningful inputs (49%).

Respondent demographic profiles

Slightly over half of respondents (53%) have more than 20 years of experience in the construction industry. A quarter of the respondents have between 10 and 20 years of experience. Only 8% of respondents have 2-5 years of experience in the construction industry. The general experience level of the survey participants therefore added to the quality of the feedback received.

In terms of scale of projects involved in, majority (56%) indicated that they were involved in projects that were in scale up to $1 million, which is the small to medium scale projects that subcontracts fall into.

In terms of the class of projects involved, majority (70%) chose commercial construction and civil construction works, which were in range of $1m -$5m, and $5m-$10m projects, respectively. Only a small portion (30%) was involved in larger projects worth more than $10 million. Responses in relation to these demographic profiles were fairly representative of the largely Wellington-based industry role players and showed a lack of major construction work currently taking place in Wellington.

In terms of which fields respondents came from, commercial and civil construction shared about a quarter of the responses each. Majority of the remaining responses came from the commercial interiors and refurbishment sector.

Concerning the nature of role played, responses were fairly evenly distributed between directors (22%), construction managers (22%), quantity surveyors (22%) and subcontractor (31%), with little responses (3%) coming from consultants. Significant responses from

directors, construction managers and quantity surveyors added breadth and quality to the feedback received.

Contractual risks faced by contractors during tendering

Respondents were asked to rate some identified risk factors in terms of their relative levels of significance. 21 individual risk factors were identified. Through thematic analysis, the risk factors were segregated into 7 broad categories as shown in Table 1.

Unforeseen site conditions were identified as the 2nd greatest risk factor from all of those identified. Wong & Hui (2006) corroborated this finding by concluding that difficulty and uncertainties around site conditions constitute one of the inflating factors to contractors' pricing in competitive tendering.

Programming risks in terms of timeframes that are too tight to achieve satisfactory completion of a project were identified as the main risk in both this category and overall. The pressure to complete a project on time is often immense, especially when costly liquidated damages are involved, which add an additional dimension in terms of financial costs and risks. Additionally the availability of key inputs such as material and labour was identified as the third most significant risk factor. This is consistent with findings in other studies such as Marcus & David (2012) and Mbachu (2011) which highlighted significant risks associated with acute shortage of skilled tradespeople. Overall project related risks were identified as one of the major risks groups, having risk components with overall rankings of 1st, 3rd, 5th and 7th in the overall risk rankings.

Table 1 shows that pricing risks comprise experience and capability of estimating team, poor design and documentation, and insufficient time given to price the work (with overall ranking of 9th, 11th and 13th). It should be noted that Karim et al. (2012) study of Indonesian contractors identified design or documentation errors as the major risk factors confronting contractors. Overall the pricing risks were identified as mid-ranking risks, suggesting that risks around initial pricing is not the major concern of most contractors, probably because many look up to variations to make up envisaged profit on a job (Mbachu, 2011).

Unreasonable expectations by the client was identified as a significant risk and ranked as the 6th most significant set of risks. This suggests that architects or consultants are possibly not doing enough to educate their clients on realistic expectations from the project team. Respondents had stronger feeling towards risks associated with working with difficult clients. The financial viability of the client was perceived as the third most risky factor within this subgroup.

Surprisingly, finance related risks factors received very low rating by the respondents. These results were at variance with the findings of Marcus & David (2012) which identified subcomponent risk factors within this group, particularly, interest rates on bank loans and overdraft facilities issues as significant risks for contractors. Perhaps, this could be because

the majority of the respondents being subcontractors did not depend on bank loans and overdraft for project financing. Mbachu (2011) noted that most subcontractors do not meet the stringent conditions for bank loans.

Table 1: Contractual risk factors impacting on tendering

	Significance level rating								
	1	2	3	4	5				
Risk factors	%	%	%	%	%	Total	Mean	Category Rank	Overall Rank
Site risks									
a) Inclement weather	8%	33%	28%	22%	8%	36	2.89	2	16
b) Unforeseen site conditions	0%	14%	36%	36%	14%	36	3.50	1	2
Project related risks									
c) Buildability issues such as complex site details or new methods that are unfamiliar	3%	11%	53%	25%	8%	36	3.25	4	7
d) Availability of key inputs such as labour, material or equipment	3%	14%	33%	36%	14%	36	3.44	2	3
e) Programme risks due to required delivery timeframes	0%	6%	22%	50%	22%	36	3.89	1	1
f) The ability or productivity of Subcontractors	0%	17%	39%	39%	6%	36	3.33	3	5
Pricing risks									
g) insufficient time given to price the work	8%	31%	19%	33%	8%	36	3.03	3	13
h) Poor design & documentation	3%	25%	42%	22%	8%	36	3.08	2	11
i) Experience & competency of the estimating team	3%	28%	28%	36%	6%	36	3.14	1	9
Risks within your own organisation									
j) Concerns around skill or competence of project team within your organisation	23%	31%	20%	23%	3%	35	2.51	2	19
k) current workload, i.e. taking on too many projects at one time	11%	25%	22%	33%	8%	36	3.03	1	12
Client related risks									
l) unreasonable expectations of the client	0%	11%	50%	36%	3%	36	3.31	1	6
m) perceived risks that may arise as a result of dealing with a particular client	0%	28%	28%	42%	3%	36	3.19	2	8
n) Concerns around the financial viability of the client	17%	25%	14%	19%	25%	36	3.11	3	10

o) Perceived risks that may arise as a result of dealing with a particular Architect or consultant	6%	33%	28%	31%	3%	36	2.92	4	15
Finance related risks									
p) interest rate changes	40%	31%	29%	0%	0%	35	1.89	3	21
q) Banks calling up or limiting overdraft facilities	39%	31%	17%	11%	3%	36	2.08	2	20
r) Possible cash flow risks, e.g. due to staging	9%	36%	26%	20%	9%	35	2.83	1	17
External risks									
s) General market conditions	0%	33%	39%	28%	0%	36	2.94	2	14
t) Shortages of skilled labour	0%	17%	36%	36%	11%	36	3.42	1	4
u) Compliance risks, e.g. H&SE Act.	17%	25%	31%	28%	0%	36	2.69	3	18

Relative levels of significance of the broad risk categories

Survey respondents were asked to rate the broad areas of risks in accordance with their relative levels of significance. Table 2 shows the results of the analysis. Site related risks received the highest mean rating of 3.31, emerging as the most significant risk category. This was followed by main contractor related risks. Surprisingly, client related risks received the lowest level of significance rating. As majority of the respondents were subcontractors, the ranking of the significance levels of the broad risk categories could be different if main contractors were the majority; main contractors have been known to prioritise client related risks as the most significant set of risks impacting on tendering price (Karim et al., 2012; Wong & Hui, 2006). Perhaps, the result may not be surprising after all, if main contractors are seen as 'clients' of the subcontractors, given the high significance rating of main contractor related risks by the respondents. Usually, in the traditional procurement system which dominates procurement system in New Zealand (Mbachu, 2011), subcontractors have contractual relations only with the main contractors, and therefore are shielded from direct influences of the client-related risks.

Table 2: Relative levels of significance of the broad categories of contractual risks

	Significance level rating							
	1	2	3	4	5			
Broad categories of the contractual risks	%	%	%	%	%	Total	Mean	Rank
Site risks	0%	14%	47%	28%	8%	36	3.31	1
Main contractor related risks	6%	17%	36%	36%	6%	36	3.19	2

Pricing risks	0%	28%	39%	25%	8%	36	3.14	3
Subcontractor related risks	3%	19%	47%	25%	6%	36	3.11	4.5
External risks	3%	22%	42%	28%	6%	36	3.11	4.5
Client related risks	3%	36%	39%	11%	11%	36	2.92	6

Risk mitigation strategies

Respondents were asked to rate identified risk mitigation strategies in terms of the frequency with which they use them in practice. Putting tags and conditions to overly risky price items or some aspects of the tender bids for which the respondents were not prepared to accept was the most frequently used risk mitigation method. This result is in agreement with similar findings by Laryea & Hughes (2011) to the end that, in the bidding process, contractors mainly dealt with unwanted risks through the addition of tags and conditions.

The 2nd most popular means of mitigating risk is to transfer the risk onto other parties. The use of these first two methods of mitigation allows the tenderer to keep their bid competitive by not requiring a contingency sum to cover the risks. The inclusion of contingency sums is only the 3rd most readily used risk mitigation strategy. This contrasts with its prominence in the literature as the most widely used risk mitigation measure (Marcus & David; 2012; Elhag et al., 2005).

Table 3: Risk mitigation strategies

	Frequency of use (low to high)							
	1	2	3	4	5			
Risk mitigation measure	%	%	%	%	%	Total	Mean	Rank
Putting tags and conditions to risky price items or aspects of the tender bids	3%	8%	17%	42%	31%	36	3.89	1
Transferring the risks onto other parties	9%	22%	33%	19%	11%	36	3.03	2
Lump sum adjustments to margin to cover identified risks	8%	33%	17%	39%	3%	36	2.94	3
Taking protective measures against risks such as liquidated damages	20%	36%	17%	14%	11%	36	2.60	4
Strategic withdrawal from the tendering by pricing uncompetitively	17%	42%	25%	11%	6%	36	2.47	5

Freely given feedback by respondents

Respondents were asked to comment generally about the topic, especially as regards to further risk factors they face while tendering for contract jobs. The following are the most recurring feedback received. They relate to issues around compliance, contract administration, construction management, costing and foreign exchange.

1. Health & Safety is a big issue. Inductions are required on site as well as a regular update meeting. This time never seems to be factored in to the schedule or pricing.

2. Environmental compliance is an issue. Costs and delay involved in guarding against pollution such as noise, dust and spills, even run-off/ sediment control are huge, often beyond the risk contingency added at the tendering stage.

3. Cultural issues, such as protection of heritage trusts or endangered species.

4. Very onerous special conditions of contract, e.g. contractors bond, unrealistic LD's.

5. High deductible on Principal's Contract Works policy, under NZIA conditions.

6. Transfer of information between tender take-off and work on site. E.g. quantity is measured as 2.7m sheets, but ordered as 2.4m incurring more waste and labour.

7. Incorrect assumptions: Actual site method being different from tender assumptions, causing a change of method or losses if ignored.

8. Incompetence, especially on the part of the subcontractors and the supervisory team.

9. Poor productivity of internal resources compared to that allowed in tender build up.

10. Ambiguity between Drawings, specification and basis for payment.

11. Subcontractor workload and prior commitments - having to get another subby at a higher cost.

12. Variations notification to client/engineer - timely notification within contract specified timeframes.

13. Delay as a result of H&S incident.

14. Cost fluctuation resulting from instability in the foreign exchange rates (especially where offshore content cost is significant).

15. Our biggest risk is when a clear error has been made in the contract documentation by the consultants or architects and they then refer to an "all capturing" clause to make

the contractor do the work. Generally the contractor has priced the job competitively to win the work at a fair margin and assumes the contract documents to be right. Lumps of contingency are not included to cover consultants' errors.

CONCLUSIONS

This paper has explored the leading contractual risk factors in the New Zealand construction industry, their risk profiles and mitigating measures. Results highlighted 21 risk factors which were segregated into 6 broad categories in diminishing levels of significance as follows: Site conditions, main contractor, pricing, subcontractor, external and client- related risks. The most risky factors under the broad categories comprise, respectively, unforeseen site conditions, poor project management, inexperience or incompetent estimating team, work overload arising from taking on too many contracts at the same time, shortage of skilled labour, and clients' unreasonable expectations.

Putting tags and conditions to risky price items or aspects of the tender bids, and transferring the risks onto other parties were analysed as the two most effective out of the 5 key risk mitigation measures identified in the study. Being cautious of the priority risk factors and implementation of the identified most effective risk mitigation measures could guide contractors and the project team to more appropriately budget for and respond to risk thereby ensuring more satisfactory project outcomes.

The findings of the study are fraught with a number of shortcomings which may limit their generalisation or application in a wider context beyond the study scope. These comprised poor responses which were not representative of the various sampling frames for the study, and exclusion of feedback from important stakeholders such as clients. Furthermore the responses were heavily biased to the favour of subcontractors who constituted the majority of the respondents. Notwithstanding the shortcomings, the findings have provided useful starting points for further debate and more detailed investigations into the subject matter.

REFERENCES

Ahmet, Ö., & Önder, Ö. (2003). Risk analysis in fixed-price design–build construction projects. *Building and Environment*, 39, 229-237.

Australia, S. (2009). *Australia and New Zealand Standards (AS/NZS) 3100: Risk Management: Principles and Guidelines*. Sydney: Standards Australia.

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

Elhag, T. M. S., Boussabaine, A. H., & Ballal, T. M. A. (2005). Critical determinants of construction tendering costs: Quantity surveyors' standpoint. *International Journal of Project Management*, 23(7), 538-545.

Hanna, A. S. (2007). Risk Allocation and Increased Claims in the Construction Industry, Editorial, *Journal of Professional Issues in Engineering Education & Practice*, pp. 43-44.

Karim, N. A. A., Rahman, I. A., Memmon, A. H., Jamil, N., & Azis, A. A. A. (2012). Significant risk factors in construction projects: Contractor's perception. *2012 IEEE Colloquium on Humanities, Science & Engineering (CHUSER)*, 347.

Laryea, S., & Hughes, W. (2008). How contractors price risk in bids: theory and practice. *Construction Management & Economics*, 26(9), 911-924.

Laryea, S., & Hughes, W. (2011). Risk and Price in the Bidding Process of Contractors. *Journal of Construction Engineering & Management*, 137(4), 248-258.

Latham, M., Procurement, J. R. o., & Industry, C. A. i. t. U. K. C. (1994). Constructing the Team: *Joint Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry: Final Report*: H.M. Stationery Office.

Ling, F. Y. Y. (2005). Global Factors Affecting Margin Size of Construction Projects. *Journal of Construction Research*, 6(1), 91-106.

Marcus, T., & David, B. (2012). Risk Pricing in Construction Tenders - How, Who, What. *Australasian Journal of Construction Economics and Building*(1), 49.

Mbachu, J. (2011). Sources of contractor's payment risks and cash flow problems in the New Zealand construction industry: project team's perceptions of the risks and mitigation measures. *Construction Management & Economics*, 29(10), 1027-1041.

Mochtar, K., & Arditi, D. (2001). Pricing strategy in the US construction industry. *Construction Management & Economics*, 19(4), 405.

Nieto-Morote, A., & Ruz-Vila, F. (2011). A fuzzy approach to construction project risk assessment. *International Journal of Project Management*, 29(2), 220-231. doi: 10.1016/j.ijproman.2010.02.002

Nutakor, G. (2007). Assessing Final Cost of Construction at Bid Time. *Cost Engineering*, 49(11), 10-16.

Oyewobi, L. O., Ibrahim, A. D., & Ganiyu, B. O. (2012). Evaluating the Impact of Risk on Contractor's Tender Figure in Public Buildings Projects in Northern Nigeria. Journal of Engineering, *Project & Production Management*, 2(1), 2-13.

Rowe, W. D. (1977). *An Anatomy of Risk*: R.E. Krieger Publishing Company.

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

Wong, J. T. Y., & Hui, E. C. M. (2006). Construction project risks: further considerations for constructors' pricing in Hong Kong. *Construction Management & Economics*, 24(4), 425-438.

Yean Yng Ling, F., & Liu, M. (2005). Factors considered by successful and profitable contractors in mark-up size decision in Singapore. *Building and Environment*, 40(11), 1557-1565.

Zou, P. X. W., Zhang, G., & Wang, J. (2007). Understanding the key risks in construction projects in China. *International Journal of Project Management*, 25(6), 601-614.