Factors Influencing Building Contractors' Pricing for Time-Related Risks in Tenders

Edwin H. W. Chan[1] and Maria C. Y. Au[2]

Abstract: The contractors' pricing for contract risks in tenders determines how much the employers have to pay for the risk transfer. Therefore, understanding the factors influencing the contractors' pricing for contract risks is crucial for employers to optimize the cost effectiveness of risk allocation in contracts. This study investigates the factors that contractors perceive to be important when they are pricing "time-related" contract risks. A questionnaire survey was designed for collecting data from building contractors currently operating in Hong Kong. Contractors were not only required to rate the importance of individual factors, but also to state the cost implications when compared with normal pricing in the absence of the concerned factor. The findings reveal that a single factor may have two-sided implications (both inflating and deflating the prices) for which they can be in unequal scales. These scales vary according to the contractor size and the reasons of the differences are investigated. The findings also assist employers in formulating a cost effective contract strategy by equipping them with the necessary knowledge.

DOI: 10.1061/(ASCE)0733-9364(2009)135:3(135)

CE Database subject headings: Bids; Pricing; Time factors; Risk management; Contractors.

Introduction

In studying the cost effectiveness of a contract risk adjustment exercise, employers may be interested in knowing what situational variables will pose substantial implications on a contractor's pricing for contract risks, which will then favorably or unfavorably affect the cost that the employers have to pay for a risk transfer. This study attempts to investigate these variables and their cost implications to a contractor's pricing for contract risks.

In view of the serious delays encountered in most construction projects, time-related risks are focused on in this study. The time-related provisions in a contract mainly lie on the extension of time (EOT) clauses, entitling contractors to have EOT to the original contract completion date in case of the occurrence of certain neutral delaying events or defaults on the part of employers. Employers can choose to transfer risks of this kind to contractors by introducing a special condition of contract for removal of the contractor's EOT entitlement. Such risk allocation through contractual provisions involves financial considerations. Tenderers would include a monetary offer in their returned tenders for bearing the risks transferred to them. The sums allowed for the risk adjustment by the tenderers can be different, mainly due to their different risk attitudes and the different situational variables influencing the tenderers' pricing at the time of submitting tenders, and this study focuses on examining the latter.

[1]Professor, Dept. of Building and Real Estate, Hong Kong Polytechnic Univ., Hung Hom, Kowloon, Hong Kong SAR, China. E-mail: bsedchan@inet.polyu.edu.hk

[2]Ph.D. Student, Dept. of Building and Real Estate, Hong Kong Polytechnic Univ., Hung Hom, Kowloon, Hong Kong SAR, China.

Note. Discussion open until August 1, 2009. Separate discussions must be submitted for individual papers. The manuscript for this paper was submitted for review and possible publication on November 28, 2005; approved on September 11, 2008. This paper is part of the ***Journal of Construction Engineering and Management***, Vol. 135, No. 3, March 1, 2009. ©ASCE, ISSN 0733-9364/2009/3-135–145/$25.00.

Aim, Objectives, and Significance

This study aims at providing guidelines to employers on how to obtain more competitive offers from tenderers by understanding the tenderers' pricing behaviors under different tendering situations (e.g., tenderers may allow lower risk buffers in tenders if the employer has a good reputation to honor payment on time). To achieve this aim, the objectives of this study are:

1. To identify the factors influencing a contractor's pricing for time-related contract risks in tenders; and
2. To evaluate the cost significance of the identified factors in submitting a bid.

The identification of these factors and their importance imposes significance in studying contractor's risk behavior in the bidding process and ultimately enhancing the cost effectiveness of a risk adjustment exercise. It also equips employers with the knowledge of the processes underlying the contractors' risk behaviors, which are crucial if the employers want to intervene the contractors' risk behaviors, and, thus, the commercial offers for the works.

Factors Constituting the "Situational Variables"

There are many variables that affect a contractor's decision to bid or not to bid, and how much to bid (Dozzi et al. 1996; Shash and Abdul-Hadi 1993). The determination of the proper mark-up size entails the evaluation of numerous factors and it varies from one bid to another, depending on a multiplicity of internal and external factors that are encountered in each mark-up decision (Shash and Abdul-Hadi 1992). It is supplemented by other research that the bidding criteria included environmental factors, company factors, and project factors in which the environmental factors were further separated into geographical, economic, and historical groups (Dozzi et al. 1996). When preparing a bid, contractors consider the resource required for the project in terms of quantity, quality, cost, and performance, and other factors such as the ex-

tent of information requirements, project environment, etc., which may affect the performance of those resources to determine the consolidated cost estimate (Akintoye 2000).

It is difficult to extract the principles of mark-up estimation from estimators as there seem to be features that are inseparably integrated in mark-up tasks. Although the mental process that estimators adopt is difficult to describe and capture, it appears that mark-up decisions simply emerge in a single step from a mixture of experience, intuition, and gut feeling (Li and Love 1999). As many of these factors are difficult to quantify, a subjective analysis can be used to evaluate such criteria in the determination of a bidding mark up (Dozzi et al. 1996). Shash and Abdul-Hadi pointed out that very few top American contractors used mathematical models to aid them in determining the proper mark-up size while the majority used subjective judgment (Shash and Abdul-Hadi 1992). This was supported by another study in 1993, which revealed that contractors in Saudi Arabia evaluated many factors subjectively when they decided on mark-up sizes (Shash and Abdul-Hadi 1993). Shash also investigated that most of the top UK contractors depended on subjective assessment in making bid/no bid and mark-up size decisions (Shash 1993). It was a common thought that many bidding and mark-up size decisions were based on contractors' experience, intuition, personal bias, subjective assessment of the conditions surrounding the bid situation, and emotional responses to the presences of the moment (Fayek 1998; Xu and Tiong 2001). In view of this high subjectivity, an empirical study is considered an appropriate method in investigating the factors affecting the bidding and mark-up size decisions.

The identification of elements constituting the "situational variables" requires the reference to previous research studying the factors affecting bid/no bid decision and the factors affecting the mark-up size decision. The relevant factors identified in these studies can serve as guiding stimuli in studying the factors affecting contractors' pricing for time-related risks.

Drew and Skitmore explained that the construction industry environment consists of general environmental factors (politics and law, economics, sociology, and technology) as well as competitive environmental factors (finance, plant, labor, management, suppliers, subcontractors, consultants, and clients) (Drew and Skitmore 1997). The main features that managers state in assessing projects are project size, project complexity, and construction method. Further, economics has strongly influenced managerial thought as well. Therefore, in deciding whether to bid, contractors are likely to consider both their current work load and future available work in the construction market.

Ahmad and Minkarah uncovered the factors that characterized the bidding and mark-up decision-making process for the top general contractors in the United States and 31 factors were identified (Ahmad and Minkarah 1988). Shash identified 55 factors influencing the tendering decisions made by top UK contractors, for which the need for work, the number of competitors tendering, and the amount of experience on such projects were identified as the top three factors that affected a contractor's decision to bid for a project, while the degree of difficulty, the risk involving owing to the nature of the work, and the current work load were the highest ranked factors affecting mark-up size decisions (Shash 1993). Wanous et al. also identified 38 factors that affected the bid / no bid decision of the contractors in Syria (Wanous et al. 2000, 2003). Chua and Li considered competition, risk, company's position in bidding, and need for work as the determining factors to contractor's bidding decision. They also addressed the effect of different types of procurement methods on the bidding decision of contractors (Chua and Li 2000).

Dozzi et al. pointed out that location, labor reliability, labor availability, market conditions, competition, future projects, historical profit and failures, current work load, project type, project size, owner, project complexity, project duration, cash flow requirements, estimate uncertainty, etc., were the factors affecting the bid mark-up decisions (Dozzi et al. 1996). Smith and Bohn further identified the factors increasing contingency mark up, namely, workload, smaller contract size, increased project complexity, lower number of bidders, employer's poor reputation, tough bidder mentality, unclear contract documents, and short bidding time frame, etc. (Smith and Bohn 1999). Akintoye had similar thoughts and considered the main factors relevant to the cost estimating practice were complexity of the project, scale and scope of construction, market conditions, method of construction, site constraints, client's financial position, buildability, and location of the project (Akintoye 2000). Dulaimi and Shan also investigated the factors influencing bid mark-up size in Singapore and the survey showed that contractor size has a significant impact on these decisions (Dulaimi and Shan 2002). These all could well be concluded by Wallwork, who suggested that the bidding price was arrived at by the combination of detailed work, an analysis of the bidder's own strength, needs and weaknesses, the particular circumstances of the project, and an assessment of the risk involved (Wallwork 1999). Table 1 summarizes the factors identified in the above literature.

Previous researchers considered risk as one of the major factors affecting the bidding decision and the mark-up size. However, they had not studied adequately the factors affecting contractor's pricing for risks during the tendering stage. This study attempts to fill this literature gap. While it is widely accepted that the factors identified in the above are the factors that contractors consider in the tendering stage, it is anticipated that these factors may generally be applicable in this study of pricing for risks.

While investigating the relevant factors and their implications, concerns are placed on whether these factors affect the pricing made by different-sized contractors in unequal scales. Skitmore, in testing the contract bidder homogeneity, concluded that not all contractors behaved collectively in an identical manner (Skitmore 1991). Different bidders will have different degrees of preference toward the individual contract characteristics, such as size, type, and location of proposed contracts; and, in determining mark-up levels, different bidders have differing degrees of selectivity between contracts (Drew and Skitmore 1997). Besides, the level of importance attributed to the factors influencing the mark-up size decision may vary with contractor size. Shash and Abdul-Hadi had proved that the mark-up decisions of small, medium, and large contractors in Saudi Arabia were influenced by different factors (Shash and Abdul-Hadi 1993). Therefore, this study also examines the similarities and differences of the factors influencing different-sized contractors' pricing for time-related contract risks.

Survey Methodology

Questionnaire Survey and Target Respondents

The literature review resulted in the identification of 46 factors under six categories (see Table 1). These factors were generally

J. Constr. Eng. Manage., 2009, 135(3): 135-145

Table 1. Factors Influencing Contractors' Pricing for Time-Related Risks

Category	Factors
Project characteristics	• Intensity of contract (the ratio of contract value and contract period)
	• Project duration
	• Location of project
	• Project start time
	• Project cash flow
	• Degree of difficulty of work
	• Risk/safety hazard
	• Contractor's involvement in the design stage
	• Portion of nominated subcontract works
	• Portion of domestic subcontract works
Employer/project team characteristics	• Public/private client
	• Financial capability of the employer
	• Employer's reputation to honor payment on time
	• Coordination and administration skills of project team
Contractor related issues	• Availability of required cash and office overhead
	• Need for work/current work load
	• Need for public exposure, marketing, or establishing long term relationship with employer
	• Past experience in similar project/company strength in the industry
	• Past relationship with employer
	• Relationship with subcontractors and suppliers
	• Past loss/profit in similar projects
	• Confidence in company work force
	• Company's policy in production cost savings/economic use of building resources
	• Reliability and cost certainty in cost estimate
Contract documentation/administration	• Lump sum/remeasurement contracts
	• D&B/traditional contracts
	• Completeness of document and design quality
	• Amount of liquidated damages
	• Risk in fluctuation in material and labor prices
	• Contract conditions/specifications
	• Insurance and bond
	• Contingencies allowed
	• Contract period
Bidding situation	• Selective/open tendering (number of competitors)
	• Competitiveness of competitors
	• Tendering duration
	• Availability of other projects in hand
	• Bidding price
Economic and social situation	• Availability of works in the market
	• Risk involved in investment
	• Employer's rate of return on the project
	• Availability and quality of supervisory persons/labor/materials/equipment
	• Labor union
	• Public objections
	• Statutory regulations and requirements on the type of works concerned
	• Tax liabilities

Note: References: Ahmad and Minkarah (1988), Akintoye (2000), Dozzi et al. (1996), Dulaimi and Shan (2002), Shash and Abdul-Hadi (1992, 1993), Shash (1993), Smith and Bohn (1999), and Wanous et al. (2000, 2003).

considered relevant to the pricing of contract risks, and a pilot study had been carried out to test their validity on the studied area. A questionnaire survey on local building contractors was adopted in this study and the factors included in the questionnaire were developed from the literature review and the pilot study results. In view of the possible differences in behavior among different-sized contractors, the respondents were classified into three groups (Group A plus those not on the list/Group B/Group C) in accordance with the list of approved building contractors maintained by the Environment, Transport and Works Bureau of the Hong Kong Government, with Group A contractors being the smaller contractors and Group C contractors being the more well-established ones. Group A contractors are for contracts of value up to HK$20 million; Group B contractors for contracts of value up to HK$50 million, and Group C contractors for contracts of any values exceeding HK$50 million.

Pilot Study

A pilot study with a questionnaire survey (containing the 46 factors) and follow-up telephone interviews was conducted with the participation of six local contractors. They were asked to identify those factors that were/were not their concerns when pricing time-related risks in tenders and to rate the corresponding importance of these factors in a five-point scale (1 being the least important and 5 the most important). All respondents are working in building contracting firms currently operating in Hong Kong. They possess 8 years to 31 years of experience working in the construction industry and their posts range from quantity surveying manager to managing director of the firms. The purpose of the pilot study is to shortlist the factors before inclusion of the same in the full-scale questionnaire survey. This exercise aims at reducing the number of factors from 46 to around 30. Following this pilot study, preliminary findings can be obtained on the following:

1. To what extent the factors identified in the literature regarding bid/no bid decisions and mark-up size decisions can be applied in contractors' pricing for contract risks;
2. Which factors applied in overseas countries are not applicable in the local industry; and
3. Which factors are particularly critical in affecting the contractors' pricing for time-related risks but are insignificant in determining the bid/no bid or general mark-up decisions.

Addressing Inflated and Deflated Pricing for Time-Related Risks

A single factor may significantly inflate the pricing for time-related risks but it may pose an insignificant effect on deflating the pricing. In view of the possible difference between a factor's effect on inflating and deflating a contractor's pricing for risks, two extreme scenarios were introduced for each factor, e.g., high versus low degree of difficulty of work. By doing this, two sets of importance factors can be obtained, one in inflating prices and one in deflating prices. The order of factors in these two sets of measurements can be different.

A list of predefined factors likely to inflate pricing and another list likely to deflate pricing were provided for importance rating. In order to avoid bias, the contractors were allowed to indicate their contrary opinions (i.e., they considered an item in the deflation list as a factor inflating their pricing or vice versa), if any, by putting an "X" in the "Comments" column. Besides, if the respondents considered that the factor did not either inflate or deflate the pricing for time-related risks, they could insert a "0" in the "Comments" column.

Merely working out the importance rating of each factor gives little information to readers on how the factors actually affect the pricing for time-related risks. So, questions were set, after the completion of importance rating, asking the respondents what were the monetary effects (percentage of inflation/deflation when compared with the normal pricing of risks in the absence of the concerned situational variable) of the factors with different levels of importance indicated. The cost implications were divided into ranges of 10% (compared with the normal pricing) for the respondents' choice.

Structure of the Questionnaire

The questionnaire was comprised of two parts: part one contained the above-mentioned two lists of factors for contractors' importance rating and indication of cost implications. Part two collected information regarding the profile of the respondents and their companies. This enabled us to ensure the adequacy of the respondents' experiences in tendering and the examination of any differences among different-sized contractors that can be carried out.

Importance and Cost Significance of Factors

The level of importance of each factor was assessed by calculating an "importance index." As two separate lists of deflation and inflation factors were provided and it was believed that the ranking of factors in these two lists were different, the survey would generate a result showing the order of importance for both the deflation factors and the inflation factors. Besides, as the respondents had specified the cost implication for each importance rating, the importance indices derived did not only give readers an immediate understanding on the order of importance but also the cost significance of the factors to contractors' pricing for time-related risks. It was reasonable to believe that the factors influencing different-sized contractors were different, so the importance ratings obtained from different groups of contractors had been analyzed and the concerned similarities/differences were determined.

The formula for calculating the importance index is:

$$\text{importance index} = \Sigma(\text{Im})(\text{Co})n/N$$

where Im=respondent's chosen importance rating [ranging from 1 (least important) to 5 (most important)]; Co=specified cost implication (in percentage compared with the normal pricing of risk); n=frequency of responses; and N=total number of responses.

The higher the importance index, the more important the factor to contractors' pricing for time-related risks. Any significant differences in pricing behavior among the three groups of contractors can be spotted out by comparing the importance indices obtained.

Research Findings

Pilot Study

Upon the receipt of the completed questionnaires from the six contractors, follow-up telephone interviews were conducted to gain a better understanding on why some factors were excluded from their consideration when pricing time-related risks and to have a preliminary assessment on their major concerns (i.e., what factors were most critical) in pricing risks so as to ensure that no major factors were missed.

The importance indices of the 46 factors were calculated based on the method of computation described earlier. Undergoing the selection process, 31 factors (each with two subfactors for deflation and inflation) were shortlisted for inclusion in the full-scale questionnaire survey. They are summarized in Table 2.

Applicability of the Identified Factors

The pilot study result revealed that 39 out of the 46 factors were agreed by three or more contractors as factors to be considered when pricing time-related risks. The remaining factors were not considered mainly due to the differences in situational variables between the local and overseas building industries. Besides, all six contractors considered the list conclusive. Therefore, the factors identified from the reference papers can largely be applied in local contractors' pricing for time-related risks.

J. Constr. Eng. Manage., 2009, 135(3): 135-145

Table 2. List of Shortlisted Deflation and Inflation Factors for Situational Variables

Deflation factors	Inflation factors
Project characteristics	
High intensity of work (high contract value/contract period)	Low intensity of work (low contract value/contract period)
Convenient location of project	Inconvenient location of project
Tentative project start time coinciding with the completion of another project in the company	Tentative project start time coinciding with the commencement date of another project in the company
Ideal project cash flow (early receipt of progress payment)	Nonideal project cash flow (late receipt of progress payment)
Low degree of difficulty (low complexity, no need to adopt special construction method, no underground obstruction, easy site accessibility, etc.)	High degree of difficulty (high complexity, need to adopt special construction method, likely to have underground obstructions and difficult site accessibility, etc.)
Little risk/safety hazard involved owing to the nature of work	High risk/safety hazard involved owing to the nature of work
Little contractor's involvement in the design stage	Substantial contractor's involvement in the design stage
Small portion of works subcontracted to nominated subcontractors	Large portion of works subcontracted to nominated subcontractors
Employer characteristics	
Sound financial capability of the employer	Poor financial capability of the employer
Good employer's reputation to honor payment on time	Poor employer's reputation to honor payment on time
Contractor-related issues	
Availability of required cash and office overhead	Unavailability of required cash and office overhead
Urgent need for work/low to moderate current work load	No urgent need for work/optimum to high current work load
Need for public exposure, marketing, or establishing long term relationship with employer	No need for public exposure, marketing, or establishing long term relationship with employer
Past experience in similar project/company strength in the industry	No past experience in similar project/no company strength being developed
Past/current relationship with employer	No past/current relationship with employer
Past profit in similar projects	Past loss in similar projects
Confidence in company work force	Lack of confidence in company work force
High reliability and low uncertainty in cost estimate	Low reliability and high uncertainty in cost estimate
Contract documentation/administration	
Traditional procurement system	Design and build procurement system
Completeness of document including well-developed design	Incompleteness of document including poor design quality
Acceptable value of liquidated damages	Amount of liquidated damages being higher than expected
Forecasted low risk in fluctuation in material and labor prices	Forecasted high risk in fluctuation in material and labor prices
Reasonable contract conditions and specifications	Onerous contract conditions and specifications
Normal insurance policies and no need to procure surety bond	Excessive insurance policies and procurement of on-demand bond
Reasonable contract period with some time buffers	Very tight contract period
Tender situation	
Long tendering duration	Short tendering duration
Bidding price being lower than normal	Bidding price being higher than normal
Economic and social situation	
Unavailability of works in the market due to poor overall economy	Generally good overall economy (availability of works in the market)
Low risk involved in employer's property investment	High risk involved in employer's property investment
Availability/good quality of supervisory persons/labor/materials/equipment	Unavailability/poor quality of supervisory persons/labor/materials/equipment
No public objections	Possibility to have public objections

Differences between Hong Kong and Overseas Construction Industries

Some factors identified in the reference papers such as the presence of labor union and local customs, etc., were not considered by most interviewed contractors in the tendering stage. Unlike some overseas countries, the adverse consequences of these factors rarely take place in Hong Kong or do not constitute any extra burden on the contractors. Besides, the survey also indicates that the following factors seldom form part of the contractors' consideration when pricing time-related risks in Hong Kong:

- Portion of works subcontracted to domestic subcontractors;
- Coordination and administration skills of project team;
- Relationship with subcontractors and suppliers; and
- Selective/open tendering (number of competitors involved).

Factors Particularly Critical or Noncritical for Pricing Time-Related Risks

There is no doubt that time-related factors would pose more implications on pricing time-related risks. Therefore, the factors such as "very tight contract period" and "amount of liquidated

Table 3. List of 10 Most Important Deflation Factors and Inflation Factors for Pricing Time-Related Risks by General Building Contractors

Deflation factors		Inflation factors	
Factor	Percentage of deflation (%)	Factor	Percentage of inflation (%)
Ideal project cash flow (early receipt of progress payment)	38	Poor employer's reputation to honor payment on time	35.33
Good employer's reputation to honor payment on time	37.25	Amount of liquidated damages being higher than expected	34.67
Urgent need for work/low to moderate current work load	35.5	Poor financial capability of the employer	34.17
High intensity of work (high contract value/contract period)	32.08	Very tight contract period	34.08
Sound financial capability of the employer	32	Nonideal project cash flow (late receipt of progress payment)	32.75
Unavailability of works in the market due to poor overall economy	31.92	Large portion of works subcontracted to nominated subcontractors	31.08
Reasonable contract period with some time buffers	30.83	Low intensity of work (low contract value/contract period)	27.5
Past/current relationship with employer	29	High degree of difficulty (high complexity, need to adopt special construction method, likely to have underground obstructions and difficult site accessibility, etc.)	27.17
Past experience in similar project/company strength in the industry	28.25	Onerous contract conditions and rigid specifications	26.75
Acceptable value of liquidated damages	26.17	Possibility to have public objections	26.75

damages being higher than expected" constitute the major factors for inflating the pricing for time-related risks, but they are only moderately important with respect to bid/no bid decisions and mark-up size decisions.

On the other hand, there are some other factors that are important in influencing the bid/no bid decisions and mark-up size decisions, but are insignificant in pricing time-related risks:

- Lump sum/remeasurement contract—the contractors opined that the type of contract itself did not pose any influence on their pricing for time-related risks. Instead, they might adopt some strategies in pricing unit rates so that a higher final contract sum (but a lower tendered sum) could be arrived at.
- Contingency allowed in tender document—most contractors believed that a larger amount of contingency allowed might reflect the intention to amend the design in a later stage, for which such variations should be accompanied by the corresponding EOT grants, so no extra time buffers would be allowed.

Findings of the Full-Scale Questionnaire Survey

Questionnaires with the 31 shortlisted factors were sent to 190 local building contractors and 60 completed questionnaires were received, representing an overall response rate of 31.58%. The 60 questionnaires consisted of 14 from Group A contractors, 20 from Group B contractors, 24 from Group C contractors, and two from contractors not on the List. Respondents to the survey include company directors, project managers, quantity surveyors, contracts managers, and estimators involved in the bid preparation exercise. More than 71% of the respondents have 8 or more years of experience working in the building industry and 65% of them possess 5 or more years of experience in bid preparation in contracting firms. The adequacy of the sample size is tested using the following formula (Kish 1965):

$$n = n'/(1 + n'/N)$$

where n=sample size (60 in this survey); $n' = S^2/V^2$; N=total population (170 approximately, including those building contractors not on the list); V=standard error of sampling distribution =0.05; S=maximum standard deviation in the population elements (total error=0.1); $S^2=(P)(1-P)=(0.5)(0.5)=0.25$; and P =proportion of population elements that belong to the defined class.

Substituting for the predefined variables and the sample size of 60, the data shows a consistency level of 94.8%. Therefore, the returned data can be representative of the professional population in Hong Kong.

Importance Ratings by all Respondents

Importance ratings are calculated for both the deflation and inflation factors based on the 60 responses received. Table 3 lists the 10 most important deflation factors and the 10 most important inflation factors. The orders of the deflation factors and inflation factors are different. Four out of the top 10 factors in the deflation list are not in the top 10 list for inflation factors and vice versa. This reveals that the shortlisted factors pose unequal scales of implications on inflating and deflating the contractors' pricing for time-related risks. Some factors are important deflation factors but they are insignificant in inflating pricing for risks and some other factors are critical in both deflating and inflating contractors' pricing for time-related risks, such as the employer's reputation to honor payment on time and his financial capability, project cash flow, intensity of work, length of contract period, etc.

Importance Ratings by Different Groups of Contractors

Although there are some common deflation and inflation factors among different groups of contractors, some factors are particularly important for one or two groups. This result is similar to Dulaimi and Shan's survey findings that contractor size has a significant impact on a contractor's attitude toward bid mark up decision making (Dulaimi and Shan 2002). When deciding the size of a bid mark up (or the pricing for time-related risks in this study), large contractors tended to be more concerned with the nature of the construction work while small contractors were more concerned about the state of their own company's finance. Table 4 lists the 10 most important deflation factors and inflation factors for pricing time-related risks in different groups of general building contracting firms. Bolded factors are common factors in the three groups, and nonbolded factors are absent in at least one of the top 10 lists. To summarize, the top six deflation factors and the top five inflation factors contained in Table 3 are the important factors in common (ranked top 10 in the individual list) for the three groups of contractors.

J. Constr. Eng. Manage., 2009, 135(3): 135-145

Table 4. List of 10 Most Important Deflation Factors and Inflation Factors for Pricing Time-Related Risks in Different Groups of General Building Contracting Firms

Group A contractors (including those not on the list)		Group B contractors		Group C contractors	
Factor	Deflation (%)	Factor	Deflation (%)	Factor	Deflation (%)
Deflation factors					
Good employer's reputation to honor payment on time	**38.75**	**Ideal project cash flow (early receipt of progress payment)**	**40.00**	**Ideal project cash flow (early receipt of progress payment)**	**36.25**
Urgent need for work/low to moderate current work load	**38.75**	**Good employer's reputation to honor payment on time**	**38.50**	**Good employer's reputation to honor payment on time**	**35.21**
Ideal project cash flow (early receipt of progress payment)	**38.13**	**Urgent need for work/low to moderate work load**	**36.50**	**High intensity of work (high contract value/contract period)**	**33.75**
Sound financial capability of the employer	**35.63**	Reasonable contract period with some time buffers	35.00	**Urgent need for work/low to moderate current work load**	**32.50**
High intensity of work (high contract value/contract period)	**33.13**	**Unavailability of works in the market due to poor overall economy**	**34.50**	Reasonable contract period with some time buffers	32.50
Unavailability of works in the market due to poor overall economy	**32.50**	Past/current relationship with employer	34.00	**Sound financial capability of the employer**	**30.42**
Past experience in similar project/company strength in the industry	31.88	Past experience in similar project/company strength in the industry	33.00	Past/current relationship with employer	29.58
Need for public exposure, marketing, or establishing long term relationship with employer	30.63	**Sound financial capability of the employer**	**31.00**	**Unavailability of works in the market due to poor overall economy**	**29.38**
Acceptable value of liquidated damages	28.13	**High intensity of work (high contract value/contract period)**	**29.25**	Acceptable value of liquidated damages	25.83
Past profit in similar projects	25.00	Past profit in similar projects	26.75	Reasonable contract conditions and specifications	25.00
Inflation factors					
Poor employer's reputation to honor payment on time	**36.25**	**Poor employer's reputation to honor payment on time**	**39.00**	Possibility to have public objections	33.54
Poor financial capability of the employer	**35.00**	**Amount of liquidated damages being higher than expected**	**37.50**	**Amount of liquidated damages being higher than expected**	**32.92**
Amount of liquidated damages being higher than expected	**33.75**	**Very tight contract period**	**37.50**	Large portion of works subcontracted to nominated subcontractors	32.29
Nonideal project cash flow (late receipt of progress payment)	**33.13**	**Poor financial capability of the employer**	**36.50**	**Very tight contract period**	**31.88**
Very tight contract period	**33.13**	**Nonideal project cash flow (late receipt of progress payment)**	**35.50**	**Poor financial capability of the employer**	**31.67**
High degree of difficulty (high complexity, need to adopt special construction method, likely to have underground obstructions and difficult site access, etc.)	32.50	Large portion of works subcontracted to nominated subcontractors	35.50	**Poor employer's reputation to honor payment on time**	**31.67**
Substantial contractor's involvement in the design stage	31.25	Low intensity of work (low contract value/contract period)	31.75	**Nonideal project cash flow (late receipt of progress payment)**	**30.21**
Design and build procurement system	30.63	Design and build procurement system	29.25	Low intensity of work (low contract value/contract period)	28.13
No past experience in similar project/no company strength being developed	30.00	Onerous contract conditions and rigid specifications	28.75	Onerous contract conditions and rigid specifications	27.92
Excessive insurance policies and procurement of on-demand bond	30.00	High degree of difficulty (high complexity, need to adopt special construction method, likely to have underground obstructions and difficult site accessibility, etc.)	28.00	Forecasted high risk of fluctuation in material and labor prices	24.38

Discussions

Deflation Factors

Similarities in the Three Groups of Contractors

"Ideal project cash flow" and "good employer's reputation to honor payment on time" are critical deflation factors in contracting firms of different sizes. These two factors are ranked the top-three deflation factors in all the three groups' lists. Another important deflation factor is "urgent need for work/low to moderate current work load." It is ranked the first, the third, and the fourth in the Group A, B, and C lists, respectively. The declining order indicates that smaller contractors place more consideration on the need for more work than larger contractors. Other important factors include "sound financial capability of the employer," "high intensity of work," and "unavailability of works in the market due to poor overall economy." They are ranked the top 10 deflation factors irrespective of the size of the contracting firm.

The above findings are tally with the results suggested in Shash and Abdul-Hadi's study which proves that (i) project cash flow is considered heavily in the mark-up size decision and (ii) the larger the size of a project is, the more attractive it is to contractors (Shash and Abdul-Hadi 1992). The substantial emphasis given by contractors to project cash flow may reflect their need for cash. Monthly cash inflow will help a contractor to pay the monthly wages and office overhead; it will also increase cash availability to a contractor giving him an economic leverage to compete for other projects. For the size of project, the "size" is modified to the "intensity of project" (the ratio of project value to project period) in this study for higher clarity as large projects may not allow sizable monthly cash inflows to a contractor's account if the project span is too long. The level of attractiveness brought by high intensity of work may even be higher in a recessive economy.

Differences in the Three Groups of Contractors

More importantly, reasons of why some factors are relatively important in one group but not in others have to be investigated. "Need for public exposure, marketing, or establishing long term relationship with employer" is the eighth highest ranked deflation factor in the Group A list, but it is not on the top 10 list for Groups B and C. This reveals that there is still room for Group A contractors, which are still establishing and do not have high market shares, to get known by more employers. They are more willing to make better offers in bids in return for higher public exposure and widening client base. This is supported by Fayek that the target margin may be adjusted to reflect the company's strategy or business plan for the market in which it is bidding (Fayek 1998). If the company is trying to break into a new market or build a reputation in a market, the margin on projects in this market would be set low. The company may temporarily sacrifice profits in an attempt to win more work. On the other hand, more well-established contractors may have developed adequate networking in the industry and are reluctant to substantially cut costs (the cost for assessed risks) for marketing purposes.

"Past experience in similar project/company strength in the industry" and "past profit in similar projects" are the top 10 deflation factors in the Groups A and B lists only, and not in the Group C list. Obviously, these factors are not the major concerns of large contractors. Large contractors have already developed company strength in the industry and they possess past experiences in most, if not all, types of building. Group C contractors should always be the most competent group in handling most types of projects as they have developed different in-house groups of expertise and possess extensive subcontracting channels. Even for some innovative and uncommon types of building, large contractors are more ready to be the pioneer in the field. Besides, larger projects usually imply better profit margin; this is the reason why many contractors want to move up on the government list (from Group A to Group C) for the eligibility to tender for larger projects.

"Reasonable contract period with some time buffers" and "past/current relationship with employer" are relatively important deflation factors for Group B and C contractors, but are not that important for Group A contractors. The reason why reasonable contract period is more influential to medium and large contractors' pricing for time-related risks is that larger contractors are more concerned about the quality and reasonableness of the contract, and they would input more resources in planning and programming the works in the tendering stage so as to ensure that their bids can cover the costs incurred. Besides, for medium and large contractors, the development of trust between the employer and the contractor causes them to submit a more competitive bid, as they have no need to allow for cost buffers for handling unreasonable employers. However, having past/current relationship with the employer places little incentive on small contractors to discount their offers and on the contrary, they may try to give a better offer to new employers for the purpose of expanding their client base.

"Reasonable contract conditions and specifications" only exists in the top 10 deflation list for Group C contractors and not in the top 10 lists for Group A and B contractors. Small contractors may try to maintain their competitiveness by keeping their tender prices low. Getting the job seems to be their ultimate aim. Large contractors, however, do not only focus on getting the job, but also ensuring that the bid truly reflects the extents of works to be carried out and the exposed risks. They are more cautious in examining the tender provisions before submitting a bid and they are more financially capable to input resources in the process.

Supplements for explaining the findings for the above two factors regarding reasonableness can be found in Drew and Skitmore's study (Drew and Skitmore 1997). Those contractors who are more selective concentrate on particular contract characteristics and those who are less selective place less emphasis on contract characteristics than on other factors such as work load or resources available. Those bidders (Group A contractors in this study) who place most emphasis on work load may be regarded as "resource driven" or "constraint driven."

Scale of Deflation

The scales of deflation for the top 10 factors under the three groups range from 25–40%, indicating that the presence of a single factor in the top 10 lists will deflate the original pricing for time-related contract risks by 25–40%. The scales of deflation for the three groups are close to each other, with Group C's deflation scale slightly lower than the other two. This indicates that the competitiveness of large contractors does not only lie on low costs, but also on their experiences and expertise. Favorable situational variables seem to be less attractive to them and, therefore, the impacts brought by these variables on the scale of deflation in large contractor's risk allowance are comparatively insignificant.

J. Constr. Eng. Manage., 2009, 135(3): 135-145

Inflation Factors

Similarities in the Three Groups of Contractors

There are five inflation factors in common in the top 10 lists for the three groups of contractors; they are "poor employer's reputation to honor payment on time," "poor financial capability of the employer," "amount of liquidated damages being higher than expected," "nonideal project cash flow," and "very tight contract period." An employer's reputation and financial capability are critical factors in influencing Group A and B contractors' pricing for risks, but are slightly less important in Group C contractors' pricing. This indicates that large contractors are more flexible in their financial resource allocation and late receipt of payment from employers poses less impact to the operation of the company. This is supported by the similar declining trend obtained for "nonideal project cash flow" in the three groups. The high liquidated damages, being ranked in the top three position for all groups, poses direct implication on the cost for delay and is considered as a major factor in inflating the cost allowance for time-related contract risks. Besides, the very tight contract period implies a high probability of having delays to the contract period, and, thus, encouraging inflation of contractors' pricing for time-related risks.

Differences in the Three Groups of Contractors

Some inflation factors are particularly important to small contractors. "Substantial contractor's involvement in the design stage" is ranked seventh in the Group A list but is not in the top 10 lists for both Groups B and C. This specifies that larger contractors are more experienced and better equipped to handle design works. They may have an in-house design team that facilitates their construction works requiring design input. The appointment of external design consultants by small contractors not only costs them high design fees, but also exposes them to higher time and monetary risks due to their lack of experience in supervising a design team.

"No past experience in similar project/no company strength being developed" is an important inflation factor for Group A contractors but is not for larger contractors. This finding is tally with another finding mentioned earlier that past experience and developed company strength are major deflation factors for smaller contractors. Large contractors are equipped with more all-rounded past experiences and expertise, and small contractors are hesitant in offering very competitive bids in the types of project not handled by them before.

"Excessive insurance policies and procurement of on-demand bond" is in the tenth rank in the Group A list but is not important in the other two. Smaller contractors may be incapable of bargaining for a good offer from insurance companies. The premium paid by these less established contractors for insurances and bonds should be higher and they may even be rejected for procurement of an on-demand bond. However, one may opine that the costs of procuring insurance policies and bond should be reflected in the preliminary cost in a tender and should not affect the cost allowance for contract risks. This is entirely sensible, so the cause of inflation is not the cost of taking out the insurance or bond, but the lack of confidence in properly managing the works. The employer's requirement of procuring excessive insurance may imply higher difficulties or exposure to hazards and the procurement of an on-demand bond may indicate the employer's higher and more stringent requirements on contractor's performance, and any failure in programming or accelerating the work to meet the tentative completion deadlines may entitle the employer the right to call for the on-demand bond.

Slightly different from the above, the following factors are more important to both Group A and B contractors but are less important to Group C contractors. "High degree of difficulty of work" is the sixth highest ranked and the tenth highest ranked inflation factor in the Group A list and Group B list, respectively, but it is not in the top 10 list for Group C. This reveals that degree of difficulty of work is more influential to small contractors. Large contractors are fairly well organized with adequate expertise in house to provide technical solutions to construction problems, whereas smaller contractors may not have the expertise in a reasonable amount to solve construction and buildability problems (Akintoye 2000).

"Design and build (D&B) procurement system" is the eighth highest ranked inflation factor in both Group A and B lists, but is not a major factor in the Group C list. Part of the reason is similar to that in the above for substantial contractor's involvement in the design stage. Besides, the D&B procurement system imposes further contractual risks on the contractor. This finding can be considered as a subsequent development of the finding resulting from Akintoye's survey, which stated the opposite view—larger contractors placed more concerns on different procurement systems than smaller contractors did (Akintoye 2000). The reasons delivered were that different procurement methods had been used for large projects and it was likely that the large contractors had noticed some cost implications associated with this variable, while small contractors had attached less importance to this factor as most small projects would use the traditional procurement method and there was nothing with which to compare the cost associated with this procurement method. With several years' development from Akintoye's study, large contractors are now familiar with the liabilities and contract risks associated with the D&B system, so their pricing for risks is less affected by this factor. In Hong Kong, the use of D&B contracts is still mainly on large projects and fitting out projects (fitting out projects are excluded in this study). Smaller contractors who lack the experience of being engaged in D&B contracts may not be familiar with the contractual liabilities and rights under the contract, but they acknowledge that there will be risks that they have not handled before. It thus results in the high risk buffers being allowed.

There are some other inflation factors that are more important to larger contractors. "Large portion of works subcontracted to nominated subcontractors," "low intensity of work," and "onerous contract conditions and rigid specifications" are important factors influencing Group B and C contractors' but not Group A contractors' pricing for time-related contract risks. These three factors are all related to the "quality" of the contract. A large portion of works subcontracted to nominated subcontractors means that the works carried out by the main contractor is of smaller value, which usually implies smaller profit margin, but the coordination and supervision duties are heavy, and the main contractor is liable to the progress and performance of the nominated subcontractors as well. Low intensity of work refers to a small contract to be completed over a long span of contract period. It is not ideal in terms of cash flow and effectiveness in resource utilization. For onerous contract conditions and rigid specifications, they mitigate the chance of having time and monetary compensation in the postcontract stage. These all make the contract unattractive to contractors. As mentioned previously, large contractors are more concerned about the nature of work and small contractors are

J. Constr. Eng. Manage., 2009, 135(3): 135-145

more concerned about their in-house issues; the said factors deteriorating the quality of the contract are likely to arouse more attention from medium and large contractors.

"Possibility to have public objections" is the highest ranked inflation factor for Group C contractors but is not in the top 10 list for both Group A and B contractors. This is an unexpected and useful finding. Public objections are not very common in Hong Kong, but they really exist, especially in some large developments. Larger contracts are likely to impose greater impacts on the surroundings, which invite public objections. Examples of these include large-scale new developments or redevelopments, which arouse much public concern on the planning of land use and developments, which affect the natural habitats. The consequence of public objections can be prolonged suspension of works. Therefore, Group C contractors consider public objection as a very important factor in influencing their pricing for time-related risks.

"Forecasted high risk in fluctuation in material and labor prices" is an important, though not critical, inflation factor for Group C contractors, but is unimportant for Group A and B contractors. This may be due to the fact that larger projects have to be completed in a longer period of time, which then exposes the contractor to higher unforeseeable fluctuation risks. Besides, as large quantities will be ordered, slight inflation in material or labor costs may cost the contractor dearly.

Scale of Inflation

The scales of inflation for the top 10 inflation factors in the three groups range from 24.38–39%, indicating that the presence of a single factor in these top 10 lists will inflate the contractors' pricing for time-related risks by 24.38–39%. The scale of inflation under the Group C list is comparatively insignificant, implying that large contractors are less sensitive to unfavorable tendering situations, or more accurately, they are better equipped to handle unfavorable situations so that they are less influenced by the same.

Key Observations of the Results

Employer's financial capability and their reputation to honor payment on time are critical in influencing contractors' pricing for time-related risks. This is supported by Smith and Bohn's survey, which reveals that some contractors account for the employer as much as the work itself (Smith and Bohn 1999). Rumors in the industry are also considerable justifications for adjusting risk buffers.

The survey findings not only prove that the scales of deflation and inflation on risk pricing imposed by a situational variable can be different but these scales on different-sized contractors can also vary significantly. The above also reveals that the scale of implication of a single factor can reach 40% of a contractor's original pricing for time-related risks. Therefore, the combination or existence of several favorable factors can cause the contractor's wholly waiving of the costs of possible delaying risks, and on the contrary, a few unfavorable factors can double the pricing. For both the concerns of deflation and inflation, the scales of implication on Group C contractors are the smallest. This illustrates that large contractors are more adaptable to different situational variables.

Conclusions

Situational variables would pose substantial effects on a contractor's pricing for time-related risks. The contractor's pricing for risks determines how much the employer has to pay for the risk adjustment exercise regardless of the actual extent of risk materialization. Should employers want to obtain more competitive bids to cover the transferred time-related risks, they have to avoid the occurrence of the inflation factors (e.g., avoid imposing unreasonable amount of liquidated damages in tenders and allow adequate length of contract duration for the works, etc.) and to promote the existence of the deflation factors (e.g., build up a good reputation to honor payment on time, introduce favorable payment terms in tenders, etc.). As contractors of different sizes are affected by different situational variables, employers should pay particular attention to the size of projects to be invested and, thus, the group of contractors to be invited for submitting bids in order to work out a more cost effective strategic plan on contract drafting and administration.

Acknowledgments

Acknowledgement is given to all parties who have made themselves available for participating in the research survey and to J. Wong, I. Young, and R. Yuen for taking part in related discussions and giving advice during their coursework exercises with the second writer. This research is supported by funding provided by the Research Grant Committee of the Hong Kong Polytechnic University.

References

Ahmad, I., and Minkarah, I. A. (1988). "Questionnaire survey on bidding in construction." *J. Manage. Eng.*, 4(3), 229–243.

Akintoye, A. (2000). "Analysis of factors influencing project cost estimating practice." *Constr. Manage. Econom.*, 18, 77–89.

Chua, D. K. H., and Li, D. (2000). "Key factors in bid reasoning model." *J. Constr. Eng. Manage.*, 126(5), 349–357.

Dozzi, S. P., AbouRizk, S. M., and Schroeder, S. L. (1996). "Utility-theory model for bid mark-up decisions." *J. Constr. Eng. Manage.*, 122(2), 119–124.

Drew, D. S., and Skitmore, R. M. (1997). "The effect of contract type and size on competitiveness in bidding." *Constr. Manage. Econom.*, 15, 469–489.

Dulaimi, M. F., and Shan, H. G. (2002). "The factors influencing bid mark-up decisions of large- and medium-size contractors in Singapore." *Constr. Manage. Econom.*, 20, 601–610.

Fayek, A. (1998). "Competitive bidding strategy model and software system for bid preparation." *J. Constr. Eng. Manage.*, 124(1), 1–10.

Kish, L. (1965). *Survey sampling*, Wiley, New York, 45–53.

Li, H., and Love, P. (1999). "Combining rule-based expert systems and artificial neural networks for mark-up estimation." *Constr. Manage. Econom.*, 17, 169–176.

Shash, A. A. (1993). "Factors considered in tendering decisions by top UK contractors." *Constr. Manage. Econom.*, 11, 111–118.

Shash, A. A., and Abdul-Hadi, N. H. (1992). "Factors affecting a contractor's mark-up size decision in Saudi Arabia." *Constr. Manage. Econom.*, 10, 415–429.

Shash, A. A., and Abdul-Hadi, N. H. (1993). "The effect of contractor size on mark-up size decision in Saudi Arabia." *Constr. Manage. Econom.*, 11, 421–429.

Skitmore, R. M. (1991). "The construction contract bidder homogeneity

assumption: An empirical test." *Constr. Manage. Econom.*, 9(5), 403–429.
Smith, G. R., and Bohn, C. M. (1999). "Small to medium contractor contingency and assumption of risk." *J. Constr. Eng. Manage.*, 125(2), 101–108.
Wallwork, J. W. (1999). "Is there a right price in construction bids?" *Cost Eng.*, 40(2), 41–43.
Wanous, M., Boussabaine, A. H., and Lewis, J. (2000). "To bid or not to bid: A parametric solution." *Constr. Manage. Econom.*, 18, 457–466.
Wanous, M., Boussabaine, A. H., and Lewis, J. (2003). "A neural network bid/no bid model: The case for contractors in Syria." *Constr. Manage. Econom.*, 21, 737–744.
Xu, T., and Tiong, R. (2001). "Risk assessment on contractors' pricing strategies." *Constr. Manage. Econom.*, 19, 77–84.