2025-11-05: This article is the corrected version of an article that appeared in vol. 7 no. 2 of this journal; see https://doi.org/10.5130/AJCEB.v7i2.10170 for the retraction notice.
A minor correction has also been made in this document to the spelling of the authors' names.

Risk Pricing in Construction Tenders – How, Who What

Marcus Towner and David Baccarini (Department of Construction Management, Curtin University of Technology, Perth, Western Australia

ABSTRACT

Construction projects are most commonly procured in Australia by means of a traditional design–tender–build model, whereby design is largely completed then contractors submit tenders in a competitive environment. Construction contractors must consider risks within their tenders. This paper reports the research findings into pricing for risk in competitive tenders by construction contractors. The research is based on structured interviews with 10 contracting personnel; supplemented by 23 responses of construction personnel from an online survey. Two common methods to price for risk are a trade-by-trade basis or an overall percentage or lump sum addition to the base estimate. Experience and intuition plays a significant role in pricing for risk in tenders and the number and type of people involved varies with project size, with greater involvement as project size increases. The most significant risks priced in tenders were: availability of resources; design or documentation errors; incomplete design; buildability issues; and inclement weather. The most significant project factors considered by contractors when pricing for risk in tenders are: value of liquidated damages; type of contract/procurement; completeness of documentation; project complexity; and current workload. These risks and project factors are primarily those over which the contractor has limited or no control.

Keywords: Construction, Risk, Tendering,

INTRODUCTION

Construction projects are most commonly procured in Australia by means of a traditional design–tender–build model (RCBCI 2002). Under traditional procurement, project delivery is a sequential process whereby design is largely completed before construction work commences and contractors submit tenders in a competitive environment (McDermott & Rowlinson 1999). Risk is an inherent element of construction contracting (Baccarini & Archer 2001). So in preparing tenders, construction organisations must estimate base costs and make management decisions to determine the amount to be added in the tender for risk. A common terminology for the financial amount allocated for risk in tenders is a contingency sum (Smith & Bohn 1999). So the main purpose of a contingency sum is counteract the risks that may occur during the course of a construction project (Mak et al. 1998; Smith & Bohn 1999).

Traditionally, contingencies for risks are often calculated as an across-the-board percentage addition on the base estimate, typically derived from intuition, past experience and historical data (Mak et al, 1998). A different contingency percentage may be calculated for each major cost element (Moselhi, 1997). The across-the-board percentage addition approach for contingency calculation is considered an arbitrary method and difficult for the estimator to justify or defend (Yeo 1990, Newton 1992). Estimation relies on estimators' intuition, experience and judgement (Liu & Ling 2003). As Flanagan and Norman (1993, p 128) note, 'the single factor that characterises all price forecasting is uncertainty…and price prediction is an art which requires both intuition and expert judgement'. Moselhi (1997) believes that most estimators use a "crystal ball" to determine contingency sums, and in most cases is determined based on gut feel, intuition and past experience with similar projects.

RESEARCH METHODLOGY

The aim of this research is to determine how construction contractors price for risk in competitive tenders. This research is basic, applied, descriptive, qualitative and quantitative (Kumar 2005; Sarantakos 2005). The research used two data collection approaches - structured interviews and online surveys. The research sample was selected on a purposive basis, according to the judgement of the researcher as to who could provide the best information to achieve the objectives of the study (Kumar 2005). The research sample comprised of construction professionals drawn from commercial and civil construction contracting organisations that are members of the Master Builders Association (Western Australia), which is an industry association with members drawn from the range of professions, trades and services in the building industry. The MBA provided access to a database of construction organisations engaged in tendering in non-residential building projects. Senior managers

at 10 construction organisations were purposively selected to be interviewed to provide qualitative data; and a further 145 construction personnel at selected commercial or civil construction contractor were invited to complete an online survey to provide quantitative data. This elicited 23 responses, giving a response rate of 15.8%. So, overall there were 33 respondents in this study.

RESULTS

Demographics

Demographic details for the interviewees and online respondents are set out in Tables 1-4, which show:

- Job title – three job types dominated the sample: Managing Director, Estimator and Company Director
- Work experience in preparing tenders – the majority have over 15 years experience
- Types of project - nearly all work in commercial construction
- Project values - respondents work on wide range of project values

Job Title	Nr	%
Managing Director	14	43
Estimator	7	22
Company Director	5	15
Project Manager	2	5
Business Development Manager	1	3
Estimating Manager	1	3
Contracts Manager	1	3
Construction Director	1	3
Chairman of Directors	1	3
	33	100

Table 1 - Respondents - Job Title

Years of experience	Nr	%
0-5 years	1	3
6-15 years	11	33
15+ years	21	64
	33	100

Table 2 - Respondents - Experience

Area of expertise	Nr	%
Commercial construction	30	91
Civil Construction	3	9
	33	100

Table 3 - Respondents - Expertise

Project values	Nr	%
Under $5m	11	34
$5m - $20m	7	21
over $20m	15	45
	33	100

Table 4 - Respondents – Project value

Pricing for risk

The ten interviewees were asked**:** *When preparing tenders is pricing, for risk a separate process to preparing the base estimate? (*Online respondents were not asked this question). This study identified three discernable approaches to determining how risk is priced in r tenders – See Table 5. The responses suggest there is no universally accepted standard or default protocol in the tendering process for pricing risk.

Risk Pricing Process	Nr
Separate to preparing base estimate	4
Integral part of preparing base estimate	3
during & after base estimate preparation	3
	10

Table 5 – Risk Pricing Process

Four respondents indicated that pricing of risk is an entirely separate process to preparing the base estimate. Two respondents stated that risk is not considered until the base estimate has been prepared. In the other two organisations, risk is priced over the same period of time in which the base estimate is prepared, however it is usually conducted by separate parties and both processes are

mutually exclusive. One respondent described this process: "*Once we receive the project documents two separate processes begin. The first process is that the estimator will work through the documents and drawings and price the quantifiable aspects of the project using standard engineering principles. At the same time other parties will identify and price any commercial, technical, environmental or OS&H risk associated with the project. So although these activities happen in parallel they are separate processes".*

In three organisations, pricing of risk occurs as an integral part of preparing the base estimate. The parties responsible for preparing the base estimate price for risk as the estimate is prepared and document any decisions or assumptions, for review by management before the tender is submitted. As one respondent explained: "*The risk is priced into the individual components of where we see the risk. When we add this contingency to each sub trade it appears as a separate figure underneath the relevant sub trade within our estimate… these amounts are then reviewed by management before the tender is submitted*

Three respondents indicated that the process in their organisation is to price risk for all trade elements of the project as the base estimate is prepared, which is a common method of pricing for risk (Ahmad & Minkarah 1988). Then risk associated with non-trade elements of the project, such as preliminaries and contractual risk, is generally priced once the base cost of the project has been established.

In summary, the responses indicate that there is no dominant process for pricing risk in tenders; rather the process is contingent upon organisational preference. These findings contrast with the literature, which tends to emphasise that pricing for risks is a separate process that follows on from preparing the base estimate.

Involvement in Pricing Risk

Interviewees were asked: *Who is involved in the process of pricing for risk?* **(**Online respondents were not asked this question). All respondents indicated that executive management was ultimately responsible for determining the price of risk, which usually occurs during a tender review or adjudication meeting. As Smith (1995) contends, tender adjudication meetings are usually attended by those who have played a significant part in preparing the estimate and representatives from senior management. Akintoye & Fitzgerald (2000) also found that approval of tender sums for both small and large projects is undertaken by senior management.

The value of the project tends to have has a relationship with the number of people involved in pricing for risk. Construction organisations tendering for projects less than $5 million may have as few as two people involved in the pricing of risk, the primary persons being the estimator and executive manager. If necessary, other members of the organisation such as additional executive managers, contract managers or site managers may also be involved. As observed by Akintoye & Fitzgerald (2000), it is unusual for small firms to have a separate cost estimating department, which means that proprietors of the firm are usually more closely involved in the preparation of tenders and the pricing of risk. In organisations bidding for projects between $5 million and $20 million, respondents indicated there are generally approximately four people involved in pricing risk - estimator, contract manager, site manager and executive manager.

All organisations primarily tendering for projects in excess of $20 million described a multi-stage process, consisting of a series of meetings or brainstorming sessions attended by members of the estimating team and executive management throughout the tender preparation period. In the two largest firms surveyed, tenders exceeding a certain value go through an iterative process and the tender is reviewed several times by people with increasingly higher levels of responsibility to ensure all risks have been adequately accounted for. The process followed by one large commercial construction contractor is:

1. The tender is prepared in a standard format and the estimating team documents where and why they have included a contingency for each trade.
2. The base estimate and all documentation are reviewed by State management.
3. The tender is reviewed by an Internal Credit Committee made up of the Managing Directors of each state to ensure due diligence has been followed and regional market conditions have been accounted for.

The responses suggest that the number and type of organisational personnel involved in the pricing of risks in tenders tends to vary with project size. Generally, as project size increases so the number and level of personnel increases with more senior management involvement. This might be expected because greater project value demands more financial investment, which one could reasonably expect to stimulate more intensive consideration on the risk pricing process in tenders.

Calculation of risk

Interviewees were asked: *"How do you calculate the amount to include for risk in your tenders"* (Online respondents were not asked this question). Interestingly, with a small sample of ten interviewees, five methods of pricing risk were identified (see Table 6), which indicates a wide range of possible approaches to calculating risks in tenders.

Methods of calculating risk	Nr
Micro	3
Macro	3
Micro + Macro	2
Construction period	2
Monte Carlo simulation	1
	11*

**Note: 11 responses from 10 respondents. One organisation uses two methods: Monte Carlo simulation for projects over a certain value; micro method for projects below this value*

Table 6 – Methods of calculating risk

Micro

Three respondents price risk on a trade by trade or elemental basis and a contingency amount is included in each trade area or element as the base estimate is prepared. One respondent explained this process: "*We price risk on a trade by trade basis as we receive subcontractor and supplier prices … We assess the suitability of the prices we receive and determine how much it should cost to do the work … We need to look at each area of the work in isolation to assess our risk and make adjustments accordingly…the same also applies for amounts we include for preliminaries and supervision".* Several authors (e.g. Smith & Bohn 1999; Karlsen & Lereim 2005) suggest the calculation of a different contingency amount for each major cost element is a common approach to pricing risk in tenders. Each major segment of the estimate is classified in terms of its degree of uncertainty and attracts its own inclusion for risk (Bent & Humphreys 1996). This method of pricing risk is considered more reliable than the simple application of one overall percentage or lump sum addition to the base estimate because it encourages close examination of each cost area (Moselhi 1997).

Macro

Three respondents prepare the base estimate then an amount is added to cover risk in all trade areas. One respondent highlighted this process: "*I always instruct my estimators to price the job in accordance with the trade prices we receive and their best guess for preliminaries and supervision. Then we will have a discussion with the Managing Director to assess the project and identify and price any extraneous factors when we are finalising the tender…It may mean we add a lump sum to cover all the risk items we have identified or we may just make a consideration in the amount of margin we apply".* Another respondent indicated they usually apply a macro approach: "*Generally we will look at a past project and say that the contingency percentage we used on that project was pretty spot on so if we do the same for the new project we should be OK … of course we will examine the documentation to identify any major differences between the projects and make adjustments accordingly".* According to Clark et al (1997), amounts to include for risk are often applied as an across-the-board mark-up typically derived from past experience and historical data. By looking at the contingency percentage for past projects, risk is priced from this benchmark.

Micro + Macro

Two respondents price some risk on a trade by trade or elemental basis as the base estimate is prepared and some risk is priced by making a lump sum or percentage addition to the base estimate. One respondent explained the process: "*For each cost centre we will look at past projects and consider any problems we have had with that area of work and include a lump sum for that trade area if we feel it is necessary for this job …as well as that, we may apply a percentage or lump sum amount for entire job if the project is particularly complex".*

Construction Period

Two respondents include for risk calculated on the duration of the construction period. From one respondent: "*We loosely calculate the amount to include based on the nominated construction period. We look at several factors to determine a rate per week which is then multiplied by the number of weeks to calculate our contingency amount".* This approach support's research by Skitmore & Wilcock (1994) that found some contractors examine the construction period stated in the tender documents to assess the feasibility of that period and if necessary they make an allowance for extra time by multiplying the weekly liquidated damages by the difference between the number of weeks stated in the

tender documents and the period they consider reasonable and practical.

Monte Carlo Simulation

Monte Carlo simulation is a probabilistic estimating technique that allows determination of an overall contingency amount. One respondent from a large organisation explained the use Monte Carlo simulation to assist in pricing risk: *"We have tender standards which dictate that we use Monte Carlo analysis for all projects valued over $100 million. However in the West Australian branch we probably use it more along the lines of any project worth over $10 million".* For projects valued at less than $10 million, the respondent indicated they use the micro method because the systems they employ for Monte Carlo simulation are quite sophisticated and require an external facilitator which is not warranted on smaller projects. Previous studies have found it is uncommon for contracting organisations to employ statistical or mathematical methods to price risk in tenders (e.g. Dulaimi & Shan 2002) and this is the case in this research

Experience and intuition

Interviewees and online respondents were asked *"How important is experience and intuition in determining the amount you include for risk in your tenders to price for risk".* All respondents agreed that experience and intuition is very important. For example: *"Each completed project builds a company's understanding of risks and how to approach future tenders with regard to risk. Many times you can't really tell the magnitude or likelihood of a risk until you have experienced its consequences"; "Pricing of risk cannot be too scientific, therefore it comes down to intuition to strike the balance between risk acceptance and competitiveness".* Many of the respondents explained that the people primarily involved in the pricing of risk in tenders have a wealth of experience, which according to Hegazy & Moselhi (1995) is more important than any procedure or tool. One respondent felt that without at least 10 years of experience it would be unlikely for an individual to have sufficient insight to adequately identify and assess the magnitude of risk to which the company may be exposed during the course of a construction project. One respondent indicated there was very little science associated with pricing risk and ultimately it was down to the best guess of experienced people to ensure all risks are covered in their tenders. Tah et al. (1994) found that contractors rely on experience and intuition to price risk in tenders and surmised that the amount included for risk is usually based on subjective judgement.

Most significant risks

From the literature, 23 risks relevant to construction contractors were identified. All 33 respondents were asked to indicate the 5 risks they felt were most significant when pricing for risk in their tender - see table 7

Examining the five risks which contractors rate as the most significant, two discernable areas of risk can be identified:

	Risks	Nr	%
1	Design or documentation errors	20	61
2	Availability of labour, materials or equipment	19	58
3	Buildability issues	19	58
4	Subcontractor/supplier ability	16	48
5	Incomplete design	14	42
6	Possible estimation error	11	33
7	Site access issues	8	24
8	Complexity of project team	8	24
9	Exchange rates	8	24
10	Inclement weather	7	21
11	Scope changes	6	18
12	Industrial relations action	5	15
13	Ecological damage/pollution	4	12
14	Financial failures of subcontractors	3	9
15	Changes in regulations/ legislation	3	9
16	Site safety requirements	3	9
17	Financial failure of owner	3	9
18	Equipment failure	2	6
19	Unforeseen site conditions	2	6
20	Low labour productivity	2	6
21	Rework	1	3
22	Political uncertainty	1	3
23	Fire	0	0

Table 7 – Most significant risks when pricing tender

Design related risks

Three of the five most significant risks - Design or documentation errors, buildability issues and incomplete design - stem from design issues. Contractors have very little control over these risks in a traditional procurement arrangement but may have to suffer any financial consequences, so they price for them in their tenders. One respondent, who has been in the construction industry for over 30 years, stated: "In *the hundreds of projects I*

have been involved with since joining this industry I cannot recall a single one where there was no conflicting or missing information in the project documents and only a foolhardy soul would not include an amount in their tender price to allow for this". This is supported by the literature, particularly in a recent study into the quality of project documentation and its impact on the efficiency and cost of Australian construction (Tilley et al. 2002). Incomplete design is a well known risk facing contractors and as Paek (1994), notes, contractors often have little or no option but to bid for projects based on preliminary, incomplete, or even non existent documentation so there is a clear need to include an amount for risk when this is the case. On the issue of buildability, one respondent stated: *It is all good and well for an architect or designer to come up with a concept but ultimately as the contractor, we are the ones who have to figure out a way to construct the facility. Ultimately all buildings can be built somehow but if the best way to go about it is not immediately clear we need to include an amount to cover ourselves for this"*

Labour related risks

Two of the five most significant risks are availability of resources and ability of the labour force or suppliers. One respondent elaborated on the risk of labour unavailability: "*In the current market with so much activity it is important to get your trades locked in for the job as soon as you can because if you don't, you often find that the people whose price you used to prepare the tender get committed on other jobs and you get left holding the baby so to speak".* Another contractor indicated that as a rule of thumb their organisation aims to get at least 70% of the trade value of the project locked in with the appropriate subcontractors before they commit a price to the client. The ability of subcontractors and suppliers to deliver their portion of the work in accordance with the contract was also highlighted as an important consideration for contractors when pricing risk. As one respondent stated: *Sometimes we will engage a subcontractor we have not worked with before and this poses a risk to us because we don't know until after the job has started if they are any good so in that situation we would generally make an allowance for this when we are pricing our tender".*

Risks considered

Using the same 23 risks in table 7, all 33 respondents were asked how often these risks are considered in the tendering process - see Table 8. As might be expected, there is a strong relationship between the risks contractors most often consider and the risks rated most significant.

However, some risks had a discernable difference between their significance and consideration rankings:

- *Unforeseen site conditions* - Contractors consider unforeseen site conditions when preparing tenders but do not see it as a significant risk. This may be due to the fact that unforeseen site conditions are often dealt with in most standard forms of contract.
- *Low labour productivity* - Contractors consider the risk of labour productivity e but do not see it as being significant. This may be because contractors attempt to only engage subcontractors they have worked with before so they can be reasonably confident about productivity rates.
- *Scope changes* - Contractors do not often consider scope changes but when they do, it is seen as a significant risk. This may be because when projects are procured using the traditional method, scope changes are typically reimbursed through the contract, and therefore contractors do not consider this as a risk which needs to be priced when preparing tenders.

Most significant project factors

From the literature, 20 project factors that may influence how risk is priced in tenders were identified. Respondents were asked to indicate the 5 factors most significant when pricing for risk in their tenders – see Table 9

	Risks	Significance Ranking	Consideration Ranking	Variance
1	Design or documentation errors	1	2	1
2	Availability of labour, materials, equipment	2	1	1
3	Buildability issues	3	4	1
4	Subcontractor/supplier ability	4	6	2
5	Incomplete design	5	3	2
6	Possible estimation error	6	11	5
7	Site access issues	7	10	3
8	Complexity of project team	8	7	1
9	Exchange rates	9	15	6
10	Inclement weather	10	5	5
11	Scope changes	11	19	8
12	Industrial relations action	12	8	4
13	Ecological damage/pollution	13	13	0
14	Financial failures of subcontractors	14	20	6
15	Changes in regulations/ legislation	15	16	1
16	Site safety requirements	16	10	6
17	Financial failure of owner	17	17	0
18	Equipment failure	18	22	4
19	Unforeseen site conditions	19	9	10
20	Low labour productivity	20	12	8
21	Rework	21	18	3
22	Political uncertainty	22	21	1
23	Fire	23	23	0

Table 8 – Risks in tenders –Significance v Consideration

	Project factors	Nr	%
1	Value of liquidated damages	19	58
2	Type of contract/procurement	18	55
3	Completeness of documentation	17	52
4	Project complexity	16	48
5	Current work load	15	45
6	Size of contract	10	30
7	Need for work	10	30
8	Duration of project	8	24
9	Location of project	7	21
10	Owner (Private/Public)	6	18
11	Economy (availability of work)	6	18
12	Escalation in material prices	5	15
13	Owner's special requirements	4	12
14	Use of nominated subcontractor	4	12
15	Past profit in similar job	4	12
16	Experience in similar project	4	12
17	Tendering duration	4	12
18	Competitiveness of competitors	4	12
19	Establishing relationship with clients	3	9
20	Project cash flow	1	3

Table 9 – Most significant project factors when pricing tender

These five factors can be grouped into three categories (Dulaimi & Shan 2002):
Contract Conditions - The type of contract has a bearing on how contractors price risk. From one respondent: "*we always look at the contract to see if there are any onerous clauses and assess how much risk the client has shoved onto our side of the fence*". Several respondents indicated that they would price risk based on the procurement arrangement. From one respondent: "*When we are tendering on a project where the design has already been completed at least we have a decent amount of information on which to base our price. When we are tendering on a project on a design and construct basis there are many more variables which have not yet been decided so the risks are higher and we will allow for this in our tender*". One respondent indicated that the most common overall contingency they apply is for time based risk: "*One of the first things we do is have a good look at the proposed*

program and if it is tight we will include an amount to cover us for liquidated damages ... if the liquidated damages are out of whack in relation to the size of the job we may even choose not to tender." Completeness of documentation is another issue contractors take into account when pricing risk. Several respondents explained that it was not uncommon for them to produce tenders without complete information. As one respondent put it: "*You often have to submit tenders based on documentation which is not 100% complete, sometimes even if the design is finished we may not have any details about finishes or door hardware or several other aspects of the project so we have to cover ourselves as best we can by allowing for this in our tender"*.

Project characteristics - Project complexity was the fourth most significant factor considered by contractors when pricing for risk. As one respondent stated: "*There are significant risks associated with tendering for a project that is particularly complex where innovative methods will be needed to complete the job… when we need to use methods we have not tried before we always include some fat to cover ourselves just in case things don't go the way we plan*". According to Akintoye (2000), the complexity of a project has direct consequences for the production rates achieved on the project and the more complex a project the greater the risk of lower than expected levels of profitability. Two respondents noted that complex projects can provide opportunities that may not be available on straightforward projects. From one respondent: "*We generally include an amount to cover us if we believe a project is particularly complex. However we often find that by using innovative construction and or management techniques complex projects can also present substantial opportunities*".

Organisational issues - Current workload was the fifth most significant factor when pricing tenders, as highlighted by one respondent: "*There is a lot of work around at the moment and we get the opportunity to tender on at least two new projects every week. We have to consider each project carefully in relation to how much work we are already doing because we need to ensure we have the resources to do all the work on our books at any given time… if we can't it can lead to liquidated damages and a world of pain"*. This respondent went on to explain that they would not necessarily choose not to submit a tender if their current work load was high but they would price the job differently to ensure they could bring more resources into the organisation if necessary. Shash & Abdul-Hadi (1992) suggest contractors are more likely to price risk in a conservative fashion if their workload is low and they need to maintain turnover.

Project factors considered

Applying the same project factors in Table 9, all 33 respondents were asked "How often are the following project factors considered when pricing for risk in your tenders?**"** – see Table10

Some project factors have a discernable difference between their significance and consideration rankings:

- *Experience in a similar project* - When deciding whether to tender for a project contractors will consider if they have the requisite experience to complete the project. Once that decision has been made contractors believe previous experience does not pose a significant risk which needs to be allowed for in their tender because if it was decided they did not have the right mix of experience they would be more inclined not to tender for the project rather than attach a price to that risk.
- *Establishing long relationships with clients* - The desire to establish an ongoing relationship with a client may lead a contractor to make a conscious decision to reduce their profit margin, so it is a consideration in the way they price their tender, but it is unlikely to be the cause of additional project risk.

SUMMARY AND CONCLUSIONS

Construction projects are most commonly procured in Australia by means of a traditional design–tender–build model, whereby design is largely completed then contractors submit tenders in a competitive environment. Construction contractors must consider risks within their tenders. This paper reports the research findings into pricing for risk in competitive tenders by construction contractors. The research is based on structured interviews with 10 contracting personnel involved in pricing for risk in competitive tenders; supplemented by 23 responses of construction personnel from an online survey. The key findings of this research are:

- There is no universally approach for pricing risk in construction tenders Two common methods to price for risk are a trade by trade basis and an overall

percentage or lump sum addition to the base estimate.

- In essence the majority of methods used to price risk rely heavily on experience and intuition. So experience, intuition and judgment play a significant role is pricing for risk in tenders and the number and type of people who provide this varies with project size, with greater involvement as project size increases.
- The most significant risks priced in tenders were: availability of resources; design or documentation errors; incomplete design; buildability issues; and inclement weather. The most significant project factors considered by contractors when pricing for risk in tenders are: value of liquidated damages; type of contract/procurement; completeness of documentation; project complexity; and current workload. These risks and project factors are primarily those over which the contractor has limited or no control. For example, quality of design and documentation, buildability, value of liquidated damages, and type of contract/procurement are mainly determined by the client's project team and set in place prior to pricing tenders. Whilst other risks or factors such as availability of resources and workload are mostly created in the economic external environment within which construction contractors operate.

In conclusion, it is interesting to note that whilst there is extensive research of risk management by construction contractors, there is very little research devoted to investigating the process by which construction organisations price these risk within competitive tenders. This paper adds to the knowledge in this area.

Project Factors	Significance Ranking	Consideration Ranking	Variance
Value of liquidated damages	1	2	1
Type of contract/procurement	2	6	4
Completeness of documentation	3	3	0
Project complexity	4	1	3
Current work load	5	5	0
Size of contract	6	12	6
Need for work	7	13	6
Duration of project	8	11	3
Location of project	9	4	5
Owner (Private/Public)	10	14	4
Economy (availability of work)	11	9	2
Escalation in material prices	12	8	4
Owner's special requirements	13	18	5
Use of nominated subcontractor	14	19	5
Past profit in similar job	15	16	1
Experience in similar project	16	7	9
Tendering duration	17	15	2
Competitiveness of competitors	18	17	1
Establishing relationship with clients	19	10	9
Project cash flow	20	20	0

Table 10 – Project Factors - significance v consideration

REFERENCES

Ahmad, I. & Minkarah, I. 1988, 'Questionnaire survey on bidding in construction', *Journal of Management in Engineering,* vol. 4, no. 3, pp. 229-43

Akintoye, A. 2000, 'Analysis of factors influencing project cost estimating practice', *Construction Management & Economics,* vol. 18, no. 1, pp. 77-89.

Akintoye, A. & Fitzgerald, E. 2000, 'A survey of current cost estimating practices in the UK', *Construction Management & Economics,* vol. 18, no. 2, pp. 161-172.

Baccarini, D. & Archer, R. 2001, 'The risk ranking of projects: a methodology', *International Journal of Project Management,* vol. 19, no. 3, pp. 139-145.

Bent, J. A. & Humphreys, K. K. (eds.) 1996, *Effective project management through applied cost and schedule control*, M. Dekker, New York.

Clark, F. D., Lorenzoni, A. B. & Jimenez, M. 1997, *Applied cost engineering,* 3rd ed., Marcel Dekker, New York.

Dulaimi, M. F. & Shan, H. G. 2002, 'The factors influencing bid mark-up decisions of large- and medium-size contractors in Singapore', C*onstruction Management & Economics,* vol. 20, no. 7, pp. 601-610.

Flanagan, R. & Norman, G. 1993, *Risk management and construction*, Blackwell Scientific, Oxford, England.

Hegazy, T. & Moselhi, O. 1995, 'Elements of cost estimation: A survey in Canada and the United States', *Cost Engineering,* vol. 37, no. 5, p. 27

Karlsen, J. T. & Lereim, J. 2005, 'Management of Project Contingency and Allowance', *Cost Engineering,* vol. 47, no. 9, pp. 24-29.

Kumar, R. 2005, *Research methodology: a step-by-step guide for beginners,* 2nd ed., Pearson Longman, Frenchs Forest, N.S.W.

Liu, M. & Ling, Y. Y. 2003, 'Using fuzzy neural network approach to estimate contractors' markup', *Building and Environment,* vol. 38, no. 11, pp. 1303-1308.

Mak, S., Wong, J. & Picken, D. 1998, 'The effect on contingency allowances of using risk analysis in capital cost estimating- a Hong Kong case study', *Construction Management and Economics,* vol. 16, no. 5, pp. 615-169.

McDermott, P. & Rowlinson, S. M. (eds.) 1999, *Procurement systems: a guide to best practice in construction*, E & FN Spon, London.

Moselhi, O. 1997, 'Risk assessment and contingency estimating', *AACE International Transactions,* vol. b, no. a1, p. 90.

Paek, J. H. 1994, 'Contractor risks in conceptual estimating', *Cost Engineering,* vol. 36, no. 12, pp. 19-22.

RCBCI 2002, *Discussion paper one - Royal commission into the building and construction industry,* Retrieved: 03/04/06, from http://www.royalcombci.gov.au/docs/DP%201%20Overview.pdf

Sarantakos, S. 2005, *Social research,* 3rd ed., Palgrave Macmillan, Houndmills, Basingstoke, Hampshire; New York.

Shash, A. A. & Abdul-Hadi, N. H. 1992, 'Factors affecting a contractor's mark-up size decision in Saudi Arabia.' *Construction Management & Economics,* vol. 10, no. 5, p. 415.

Skitmore, M. & Wilcock, J. 1994, 'Estimating processes of smaller builders', *Construction Management & Economics,* vol. 12, no. 2, pp. 139-154.

Smith, G. R. & Bohn, C. M. 1999, 'Small to Medium Contractor Contingency and Assumption of Risk', *Journal of Construction Engineering and Management,* vol. 125, no. 2, pp. 101-108.

Smith, N. J. (ed.) 1995, *Project cost estimating*, T. Telford, London.

Tah, J. H. M., Thorpe, A. & McCaffer, R. 1994, 'A survey of indirect cost estimating in practice.' *Construction Management & Economics,* vol. 12, no. 1, p. 31.

Tilley, P., Gallo, G., Lucas, G., McLennan, A. & Parminter, T. 2002, *Project Documentation Quality and its Impact on Efficiency in the Building & Construction Industry*, Queensland Division of the Institution of Engineers, Australia, Brisbane