2 Risk Pricing in Construction Tenders – How, Who, What

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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

	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

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

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:

INTRODUCTION

Participants to construction projects are faced with sets of interacting problems, ranging from the technical and organisational to the social and political (Flanagan and Tate, 1997). These problems all embrace concerns about the environment within which they function, the framework of society, the roles of the key players, and the motivation of the individuals involved (Flood and Jackson, 1991). It is in this environment that the quantity surveyor, as a professional consultant in the construction industry, is expected to fulfil a competent cost management role for the design team, and more specifically, for the client.

The procurement process associated with construction projects is difficult from a management point of view. The fragmented nature of the contracting industry, particularly the traditional separation of design and construction, the uniqueness of construction projects and the temporary nature of project organisations places great dependence on the project team in setting up the building process and bringing the project to a successful completion. Once client objectives have been established, a fundamental aspect of the procurement process that requires early attention is the

selection of the most appropriate organisational structure (procurement system) for the design and construction of the project (Masterman, 1992). Franks (1990) describes 'the amalgam of activities undertaken by a client to obtain a new building' as a building procurement system.

The various procurement systems may be grouped together into three generic forms, namely: conventional (conventional, negotiated, cost-plus); design and build (design and build, package deal, turnkey, develop and construct); and management-orientated (management contracting, construction management, design and manage). Bowen *et al.* (1999), in examining client briefing processes and procurement method selection in South Africa, reported that clients and their professional advisors overwhelmingly favour the traditional forms of procurement; most notably the conventional method. Their research also established that, whilst the majority of clients require assistance in procurement method selection, few design team members are *au fait* with the characteristics associated with different procurement systems and little attempt is made to match procurement system attributes to client needs. One of the most important functions of the design team within the context of its temporary management structure is the provision of effective cost management (Bowen and Edwards, 1998).

Hall (1998) argued that research undertaken in the field of cost planning and control has tended to focus on the technical aspects of the process of cost planning and control. Furthermore, that there is little evidence in the published literature of a concern for the organisational, social and political problems inherent in the process of cost planning and control and their impact on the ability of the quantity surveyor and the design team to meet the client's needs and objectives. In this context the design team is seen as a temporary management structure in terms of which internal and external stakeholders interact in an effort to satisfy the needs of the client.

A failing inherent in the documented research aimed at describing or improving the cost management system is the failure on the part of researchers to acknowledge the human aspect in management, let alone the application of a qualitative research methodology to the process of cost planning and control. Loosemore (1994) argued that the human element in any management situation is particularly important in dealing with unexpected problems since it is the interaction between the participants to the situation which must ultimately resolve any problems that arise. It is argued by Seymour and Rooke (1995) that the traditional approaches to cost planning and control research have resulted in a disparity between the world that the design team functions in and the idealized version of it that has been provided by traditional scientific approaches to research. It is further contended by Seymour and Rooke (1995) that, in attempting to improve the design team's ability to achieve the client's needs and objectives, it is this informal knowledge of the human element inherent in the design team that should be the focus of future research. Within this context the management of the human element in delivering the clients' needs and objectives becomes vital and failure to take cognisance of this factor in the design team may result in the team's inability to achieve the client's objectives.

Hancock *et al.* (1996) argue that the overall success of a construction project is to some extent determined by the degree to which the human element is managed. It is further argued by Marsden (1996) that the provision of value for money to the client can only be attained via trust, commitment, honest interaction and high quality communication between the client, the design team and all other parties involved on the project. Within this context the management of the human element is vital and failure to take cognisance of this factor in the design team may result in the team's inability to achieve the client's objectives. It is proposed that a reason for this failure is that the research undertaken into the cost management system has failed to focus on the humanistic aspects inherent in the system. Little or no qualitative research has been undertaken into the inter-relationships between the members of the design team despite calls from a number of researchers for a 'change in thinking' and new perspectives on the cost management system. Hence, there is a need for qualitative research to be conducted into the humanistic aspects of the cost management system. This paper documents the results of a qualitative study that made use of soft systems methodology to investigate the inter-relationships between the members of the design team within a temporary management structure. In achieving this objective, a constructivist methodology is

employed. 'Constructivism' is founded on the basic principle that reality is a socially-constructed phenomenon (Robson, 2002 *citing* Guba and Lincoln, 1994). Hence, in this study the researchers attempted to gain an understanding (from multiple perspectives) of the 'reality' of perceptions of the cost management system. This 'reality' was achieved *via* the use of interviews and the active participation of the research participants in constructing this 'reality' in the mind of the researchers.

SOFT SYSTEMS METHODOLOGY (SSM)

Soft Systems Methodology (SSM) was developed by Checkland (1981) for utilisation where problem situations are ill-structured and no clear view exists as to what action should be taken to overcome the difficulties being experienced. It evolved as a result of the criticisms levelled at the earlier 'hard systems' approaches and their inability to explain human behaviour within a system (Gharajedaghi, 1985). SSM may be seen as a problem-solving approach that was developed for the purposes of gaining understanding about systems that involve activities undertaken by humans. Checkland (1981:191) defines SSM as a '*strategic framework for guiding intervention in real world situations and as a general problem-solving approach appropriate to human activity systems*'. In essence, SSM is an organised way of exploring problem situations in that it provides an organised set of principles which guide action in trying to 'manage' real-world problem situations (Checkland and Scholes, 1990). SSM has four key features that need to be considered. The first is that it is a continuous learning system about the perceptions of the key stakeholders; secondly, cultural feasibility dominates the identification of organisational and/or social constraints in the 'real world'; thirdly, it encourages the participation of those involved in order to draw on the widest variety of perceptions about the situation; and lastly, it distinguishes between 'real world' thinking and ideal systems thinking (Flood and Jackson, 1991).

There are seven stages that comprise SSM. Each of these stages will be discussed in terms of its application to the cost management system and, more specifically, the identification of the inter-relationships between members of the design team and the environment within which they function.

SSM AND COST MANAGEMENT SYSTEMS

The specific objective of the research was to establish and examine, from a humanistic perspective, the perceptions and inter-relationships between the key participants to the cost management system and their resultant impact on the ability of the design team, and more specifically the quantity surveyor, to achieve the client's needs and objectives.

Results

Stages 1 and 2

Stages 1 and 2 of the research were concerned with the development of a verbal 'rich picture' of the management of the design team. This rich picture is aimed at representing pictorially all the relevant information and relationships in the situation under investigation (Patching, 1990). Pilot interviews were undertaken with three architectural practices, three quantity surveying practices, three client organisations and three contracting organisations who are actively involved in the construction industry in South Africa. The interviewees were asked to comment on the role of the individual members of the design team and on their perceptions as to the factors affecting the team's ability to meet the client's needs. Interestingly, the quantity surveyors collectively as a group commented that the quantity surveyor, client, architect and engineer are all 'committed to delivering the project within budget'. In contrast, the architectural group argued that 'the engineer is not a part of the design team in terms of meeting the client's needs'. Interestingly, the client group indicated that one of the largest contributing factors for the design team's inability to meet their needs is the 'attitude of the quantity surveyor in terms of having no direct risks associated with the project'. It is also noteworthy that the contractor group indicated that 'valuable cost related information can be provided by the contractor during the design stage' and that this is one of the major reasons for design team's inability to meet the client's needs.

As a result of the pilot interviews, a provisional system boundary was drawn around the quantity surveyor, architect, client and engineer as within the traditional procurement system they comprise what is known as the 'design team'.

Stage 3

In this stage, 'root definitions' were constructed for the relevant human activity systems identified in Stages 1 and 2. The root definition is intended to encompass the main properties of the system under examination and is defined in terms of the CATWOE mnemonic, where: C = customer (people affected by the system); A = actor (people participating in the system); T = transformation (the transformation carried out by the system); W = Weltanschauung (worldview); O = owner (the person who could stop the activity of the system); E = environment (the wider system within which the system being reviewed falls).

During this stage a root definition (RD) for each stakeholder to the cost management system is formulated. Following the compilation of the RD's for each of the stakeholders the analyst draws all viewpoints together and formulates a RD for the overall system. Hence, the RD for the overall cost management system was identified as being: "*The cost management process is a client-owned system, staffed by professionals (architects, quantity surveyors, engineers and clients) which plans and organises the delivery of a building to the client*".

In other words, the system manages the delivery of the client's needs and objectives i.e., time, cost and quality, in terms of facilitating design, maintaining the cost budget within the time constraints allowed, and operates according to the principles laid down by the professional institutions, the national building regulations and the local authority planning requirements.

Stage 4

Conceptual models for each of the stakeholders were developed on the basis of each RD during Stage 4. The purpose of the conceptual model is to clearly set out the task defined in the RD. Based on the conceptual model developed for each of the stakeholders, the analyst is able to develop an overall conceptual model that encompasses all stakeholders 'worldviews' of the cost management system. For the sake of brevity, only the overall conceptual model is documented in the paper. The overall conceptual model developed for the Root Definition stated above is provided in Fig. 1.

The activities needed to achieve the overall RD (the cost management process is a client-owned system, staffed by architects, quantity surveyors, engineers and clients, which plans and organises the delivery of a building to the client) as depicted in Fig.1 would be: client defines needs; client appoints the professional team; the professional team determines the client's needs; the team develops the brief; the team prepares the design and evaluates the cost, time and quality aspects of the design proposal; the team either complies with the client's requirements in terms of time, cost and quality, or the design team develop design further; the client monitors and controls the effectiveness of the system in achieving value for money in terms of balancing time, cost and quality.

Stage 5

Stage 5 of the SSM process requires the comparison of the stakeholder conceptual models and the overall conceptual model developed in Stage 4 with what is exists in reality. The purpose of this comparison is to identify potential problem areas within the cost management system. This exploration involved further discussions and interviews with participants to the problem area and observations of the problem situation itself in order to establish if the activities represented in the models exist in reality. Participants were leading practitioners in each respondent group identified by the initial root definition, namely: architects, clients, quantity surveyors and engineers. Each of these participants was asked to comment on any other potential stakeholders to the cost management system, where a stakeholder is defined as any person who 'has an affect on' or 'is affected by' the system under investigation (Patching, 1990). As a result further participants to the cost management system were identified, namely: contractors, town planners, land surveyors and project managers.

Client discussions - The discussions held with client organisations active within the construction industry revealed that they perceive the cost management system as a service provided by the design team, namely: the client, architect, quantity surveyor, engineer and interestingly the contractor, that entails a number of activities for example: cost control, cost budgeting and cost assessment of the project i.e., it is a cost management service that is provided by the design team. This is in contrast to what is suggested in the literature on the theory of cost planning and control which argues

that the purpose of the cost management system is, firstly, to provide the client with value for money, secondly, to achieve a balance of expenditure between the various parts of the building and, lastly, to keep expenditure within the amount allowed by the client (Flanagan and Tate, 1997). Moreover, in reality, clients perceive the contractor to be a part of the design team, whereas in theory they are excluded from this role in the design phase of traditional project procurement. Furthermore, the clients interviewed expressed dissatisfaction with the apparent inability of the design team to provide accurate estimates of the cost of building and their lack of appreciation for the risk and uncertainty involved in building work (see Pearl *et al.*, 2003 and Bowen, 1993).

Architect discussions - The discussions held with architects highlighted that they perceive cost management as a system that provides the client with a financially viable property investment. This is in contrast to what is documented in theory (Bowen, 1993). Viability studies were very low down on the list of priorities, which from the architect's perspective would view the cost management system as facilitating the design process and not ensuring the client of a financially viable property investment. Once again, as with the clients themselves, architects believe that the contractor is a part of the design team and has a valuable role to play in facilitating the design team's ability to meet the client's needs and objectives. The architects interviewed did, however, criticise the cost management system for 'stemming' enthusiastic design philosophy and believed that the main reason for this was primarily due to the quantity surveyor's failure to understand the purpose of the cost management system. Moreover, that the reason for this inability to service the needs of the architect was due to the quantity surveyor not understanding the client's needs and objectives, firstly, in terms of the information contained in the brief; secondly, in terms of balancing time, cost and quality; and thirdly, in terms of the architect's need meet the client's time, cost and quality requirements in their design solutions. Bowen *et al.* (1999) found evidence of design team members displaying little effort at embracing the building objectives of the client. Clearly, this perception held by the architect, of the quantity surveyor only managing to 'stem' enthusiastic design philosophy, can create inter-personal conflict within the design team as to the role and purpose of the quantity surveyor within the design team, and more specifically, the cost management system.

Quantity surveyor discussions - The discussions held with the quantity surveyors highlighted that they perceive the cost management system to be a system that provides the professional support needed by the client in order to provide the client with a financially viable property investment in terms of achieving a balance between time, cost and quality. Once again, as with the discussions held with the clients and the architects, the environment identified in which the cost management system operates was seen to be the same. Interestingly, the quantity surveyors interviewed perceive themselves as being the principal agent on the project and, in many ways, resent the traditional role played by the architect as principal agent. This perception of themselves has the potential to exacerbate inter-personal conflict between the architect and the quantity surveyor in that they both believe themselves to be managing the design team and the delivery of the client's needs and objectives in terms of time, cost and quality. The quantity surveyors interviewed also believed that the quantity surveyor is appointed too late in the project to provide an effective cost management service for the client and is therefore unable to ensure the financial viability of the property investment. This further inhibits their ability to meet the client's needs and objectives in terms of time, cost and quality. One comment that arose out of the discussions was the general perception among quantity surveyors that clients tend to set unrealistic budgets. Research has indicated that clients are not always knowledgeable with regard to desired goals in terms of budget limits, building functionality and desired rate of return (Bowen *et al.*, 1999).

Engineer discussions - The discussions held with the engineers revealed that they perceive the cost management system purely as a cost control system, exactly in line with what is documented in the literature. The engineers interviewed felt that quantity surveyors and, more specifically, the cost management system fails to take into account the engineering aspects of any construction project. Furthermore, they believe that there is a general lack of awareness on the part of

quantity surveyors as to the importance of cost planning and control in the design team and in terms of achieving the client's needs and objectives in terms of time, cost and quality. Another interesting factor that arose out of the discussions with the engineers was that they perceive the land surveyor and the town planner to be a part of the design team. Moreover, that these professionals have an impact on the cost management system and therefore on the team's ability to achieve the client's needs and objectives and therefore achieve a balance between time, cost and quality. As a result of the engineers identifying the land surveyor and the town planner as being a part of the team, discussions were held with these two groups to determine their perceptions of the cost management system..

Contractor discussions - The contractors interviewed identified a wish to move away from the traditional manner in which buildings are procured i.e., the traditional building procurement system. They believe that they should be involved in the design process as they have the potential to provide meaningful input to the client in terms of the priceability and buildability of the building. The contractors further criticised the inability of the architect to ensure the efficient running of the project and did not think that the architect should be appointed as the principal agent. They believed that the role of principal agent should be left to the project manager or quantity surveyor. As before, this different perception of the role of the quantity surveyor within the design team and the cost management system, has the potential to create inter-personal conflict between members of the design team in the attainment of the client's needs and objectives in terms of time, cost and quality. Due to the fact that the contractor had identified the project manager as having an impact on the cost management system, further discussions were held with project managers as to their perceptions of the management of the design team and cost management system. The contractors criticised the failure on the part of quantity surveyors to have sufficient understanding/knowledge of the physical construction process that occurs after the acceptance of the tender in the traditional building procurement process. As a result of this lack of understanding, contractors believe that the quantity surveyor is unable to provide an accurate cost estimate of the building for the client and therefore question their ability to accurately meet the client's cost requirement.

Town planner discussions - The town planners interviewed generally did not criticise the cost management system, but did, however, feel that the professional fee structures for services rendered should be altered to reflect the amount of work that is undertaken during the design stages of the project, usually 'on risk' by all the professionals involved in the design team.

Land surveyor discussions - The discussions held with the land surveyors identified that they perceive the cost management system as being a system that provides the client with a financially viable property investment. The land surveyors criticised the cost management system for being unable to meet the client's requirements, in terms of time, cost and quality, primarily due to the lack of communication between the members of the design team involved on a project. Empirical research supports this contention (Bowen, 1993). Additional reasons cited for the failure of the cost management system to meet the client's needs and objectives were seen to be the existing professional fee structures and the fact that cognisance is not taken by the design team of the elements of risk and uncertainty that are inherent in property investment.

Project manager discussions - The project managers interviewed perceive the cost management system as a rigid process that has developed historically and one which does not allow for the complex nature of the design process and the interactions between members of the design team. In addition, the negative perceptions that exist between the members of the design team of each other's role in the design team and their respective roles in the delivery of the client's needs and objectives in terms of time, cost and quality (role ambiguity – see Bowen *et al.*, 1999), severely inhibits the team's ability to meet the client's needs and objectives. The cost management system is, however, seen as being an essential service that is provided by the design team to the client to ensure the financial viability of the project. Furthermore, the project managers argued for the early appointment of the quantity surveyor on the project, the removal of trade bills of quantities, and the removal of the use of the traditional building procurement system in the construction industry.

This phase of the research project highlighted the increased number of participants to the cost management system and the complexity of the environment in which these participants are expected to achieve the client's needs and objectives. This facilitated the development of a revised stakeholder root definition's and subsequently the overall root definition for the cost management system. Hence, the RD for the cost management system in the 'real world' is:

> *A client-owned system, staffed by a team of professionals (client, architect, quantity surveyor, engineer, contractor, land surveyor, town planner and project manager) which plans, organises, manages and delivers a financially viable property investment to the client. The system manages the delivery of a cost management service to the client, architect and engineer and operates within an environment governed by uncertainty and change.*

Once again individual stakeholder conceptual models were constructed from the root definitions and an overall conceptual model for the cost management system was developed. The overall conceptual model for the cost management system is depicted in Figure 2.

The activities contained in this conceptual model of the 'real world' would be: clients define their needs in terms of this project; client appoints the design team who are to manage and deliver these needs; the design team must clearly identify and establish the client's needs; the architect and the engineer develop design alternatives; the quantity surveyor determines the cost of the design proposal; the quantity surveyor and the client determine the expected rate of return on the project; the architect and engineer further develop the detail design; the quantity surveyor manages the cost of the design; the design team organise and manage the project and, lastly, the design team deliver a cost management service and, ultimately, a financially viable property investment.

The development of the above conceptual model of the cost management system allows for the real world/systems world comparison and the identification of potential changes to the cost management system.

Stages 6 and 7

Stage 6 of the SSM process is aimed at identifying and deciding on those changes that may be made to the cost management system in order to facilitate its effective functioning in the achievement of the client's needs and objectives. In terms of the investigation of the cost management system, as depicted in Figs. 1 and 2, respectively, and an analysis of the conceptual models, the following implementable changes were identified.

Attitudinal changes - These changes pertain to peoples' perceptions of the cost management system and, therefore, facilitate the introduction of structural and procedural changes to that system. The attitudinal changes identified by the analyst via the application of SSM to the cost management system are he activities contained in this conceptual model of the 'real world' would be: clients define their needs in terms of this project; client appoints the design team who are to manage and deliver these needs; the design team must clearly identify and establish the client's needs; the architect and the engineer develop design alternatives; the quantity surveyor determines the cost of the design proposal; the quantity surveyor and the client determine the expected rate of return on the project; the architect and engineer further develop the detail design; the quantity surveyor manages the cost of the design; the design team organise and manage the project and, lastly, the design team deliver a cost management service and, ultimately, a financially viable property investment.

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facilitate the introduction of structural and procedural changes to that system. The attitudinal changes identified by the analyst via the application of SSM to the cost management system are:

- greater clarity is required among members of the design team with respect to the fundamental purpose of the cost management system;
- there is a need for increased understanding between members of the design team with respect to what services the cost management system can provide to the client and the design team in meeting the client's needs and objectives in terms of time, cost and quality;
- recognition is needed in the industry at large as to who is involved i.e., has a 'stake' in the delivery of the cost management system. Those identified by the interview process were: architects, clients, contractors, engineers, land surveyors, project managers, quantity surveyors and town planners;
- greater understanding is required as to the role and purpose of the participants in the cost management system and their perceptions of the process itself. Moreover, clarity with respect to the role of the cost management system in the construction industry is required;
- there is a need for greater understanding with respect to the needs and objectives of the clients of the construction industry and a realisation that meeting those needs and objectives is the *raison d'être* of the design team;
- there is a need for increased understanding of the role of the engineering aspects in the design and the impact that they have on meeting the client's needs and objectives in terms of time, quality and cost;

Structural changes - Structural changes relate to the tasks involved in, and the role responsibilities of, the participants to the cost management system. Those structural changes identified are:

- identification of all participants to the design team is required at the outset of the project. Those identified are the: client, architect, quantity surveyor, project manager, engineer, contractor, land surveyor and town planner;
- all participants to the design team must be appointed at the outset of the project i.e., inception;
- the roles and responsibilities of all participants to the cost management system need to be identified and stated at the outset of the project;
- management structures indicating lines of communication, roles and responsibilities need to be defined.

Procedural changes - These changes relate to the process and work activities involved in the cost management system. The procedural changes identified are:

- all the participants to the design team must be appointed and actively involved in the project from the inception stage;
- the client must appoint one clearly defined 'team leader', who is then responsible for the management of the design team;
- the professional fee scales must be changed to reflect the amount of work that is being undertaken by the design team prior to the physical construction process.

CONCLUSIONS

At this point the research has yielded a list of culturally feasible and systemically viable changes. These changes are related to the intrinsic sociological, behavioural and attitudinal aspects of the cost management system i.e., they are 'soft' issues. Soft systems methodology has served to provide insight into those issues inherent in the construction industry as a whole in South Africa, and more specifically, the process of cost planning and control. The research documented in this paper has served to emphasise the importance of an understanding of the socio-cultural and socio-political factors inherent in the design team as a temporary management structure. Moreover, it has forced a recognition of the conflict that may arise within the design team as a result of differing perceptions between participants to the process of cost planning and control.

Having established that in practice these 'human' issues do have an impact on the overall cost management system, it was unclear as to how these desired changes would be implemented in practice. More specifically, it was unclear as to what influence these changes would have on the cost management system, the role of

the quantity surveyor, and the ability of the design team to meet the client's needs and objectives in terms of time, cost and quality. Consequently, future research would need to test the potential impact the introduction of these 'changes' would have on the cost management system.

It can be concluded that the systemic approach, although not the panacea for all the industry's problems, does provide meaningful insight into the sociological complexities inherent in the design team as a temporary management structure.

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