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Project cost estimation techniques used by most emerging building contractors of South Africa

Peer reviewed and revised

Abstract

This article investigates newly emerging building contractors of South Africa who are expected to survive by projects obtained mainly through tendering. Some of these contractors fail even before obtaining the first tender while many fail in the first three years of their formation.

The research population used was restricted to formally registered businesses found at the time in the register of the Construction Industry Development Board (cidb). The population of 792 businesses, registered as Grade 5 class, consisted of five distinct types of contractors, general builders, civil engineers, electricians, mechanical builders and other sundry players. A sample of 160 was used which is approximately 20% of the population. The literature was reviewed on tendering and related aspects: competitive bidding, estimating activities, pricing a tender, and evaluating a tender. The research tool used was a questionnaire, which investigated biographical and company information, proposal management and estimation, programming and scheduling, estimating strategies, understanding of basic cost concepts, project risk management, pre-tender internal price evaluation, and tender submission.

Findings of this research revealed that South African emerging contractors showed inadequacies and variations in cost concepts, scheduling tools, risk management and tender price estimation. They also lacked essential resources and skills for competing for tenders. Emerging contractors are advised to use consultants to assist them and/or subcontract to established contractors with a reputable history. They should use these opportunities to learn superior estimation methods (which are also more complex) and apply them to improve their own tendering practices.

Keywords: Cost estimation, estimation methods, emerging contractors, tender

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Abstrak

Hierdie artikel ondersoek nuutontluikende boukontrakteurs van Suid-Afrika wat moet oorleef op projekte wat hoofsaaklik deur tenders verkry word. Sommige van hierdie kontrakteurs raak bankrot nog voordat hulle die eerste tender gekry het, terwyl baie bankrot speel binne die eerste drie jaar van hul ontstaan.

Die navorsingspopulasie wat gebruik is, was beperk tot formeelgeregistreerde besighede wat toe gevind kon word in die register van die Konstruksie Industrie Ontwikkelingsraad (Construction Industry Development Board Die populasie het bestaan uit 792 besighede, geregistreer as graad 5-klas, bestaande uit vyf afsonderlike tipes kontrakteurs, algemene bouers, siviele ingenieurs, elektrisiëns, meganiese bouers en diverse rolspelers. 'n Monster van 160 is gebruik, wat ongeveer 20% van die populasie is. Die literatuur is nagegaan oor om vir iets te tender en verwante aspekte: mededingende bie, voorleggingsbestuur, beramingsaktiwiteite, risikobestuur, prys van 'n tender en evaluering van 'n tender. Die navorsingsinstrument wat gebruik is, was 'n vraelys wat die biografiese en maatskappyinligting ondersoek het, naamlik voorleggingsbestuur en beraming, programmering en skedulering, beramingstrategieë, begrip van basiese kostekonsepte, projek risikobestuur, voor-tender interne prysevaluasie en tendervoorlegging.

Bevindinge van hierdie navorsing het getoon dat Suid-Afrika se ontluikende kontrakteurs ontoereikendhede en variasies in kostebegrippe, skeduleringsinstrumente, risikobestuur en in tenderprysskatting toon. Hulle het ook 'n gebrek aan noodsaaklike hulpmiddele en die vermoëns om mee te ding vir tenders. Daar word aanbeveel dat ontluikende kontrakteurs konsultante moet gebruik om hulle by te staan en/of dat hulle moet subkontrakteer by gevestigde kontrakteurs wat 'n hoog aangeskrewe reputasie het. Hulle moet hierdie geleenthede gebruik om uitmuntende beramingsmetodes (wat meer ingewikkeld is) te leer en toe te pas om hul eie tenderpraktyke te verbeter.

Sleutelwoorde: Kosteberaming, beramingsmetodes, opkomende kontrakteurs, tender

1. Introduction

South Africa's emerging construction enterprises seem to deviate from global trends in costing projects, and differ according to provinces. The Western Cape, Gauteng and KwaZulu-Natal provinces are more advanced and more urban compared to the other six provinces (Eastern Cape, Free State, North-West, Northern Cape, Limpopo, and Mpumalanga) by virtue of having more urban than rural areas and being richer (Bond, 1999; Gumede, 2010). Emerging contractors in the various provinces seem to suffer from the way they develop project proposals, mainly in terms of costing. Thus, when tendering for large projects there are discrepancies with regard to the way in which the contractors in the different areas cost their projects, which seems to disadvantage some of them. Large and experienced contractors, on the other hand, do not experience this problem. They have survived time while emerging ones seem to fail quickly and in large numbers.

The South African construction outlook is published by the Construction Industry Development Board (cidb, 2007). The cidb (2007) reveals an oversubscription of emerging contractors who contribute about 80% of the registered contractors. One advantage of the emerging contractors is that the developed contractors need them to secure large projects. Emerging contractors can find and secure a partner who can empower them through exposure, skills transfer and revenue while collaborating on large projects. The trend, however, seems to be that many emerging contractors prefer to compete against large contractors instead of opting to partner with them. In some cases, they compete with limited knowledge. The cidb is available to help contractors, but contractors should take the initiative to apply to be assisted with their needs. Emerging contractors are the main target of the cidb support. Despite the preferential procumbent policy by government and the cidb, the contractors fulfilling composition conditions do not necessarily win tenders for large projects if they cannot convince the prospective client that they can perform the tasks required. No company would award large projects to contractors who 'obviously do not understand the magnitude of the task'. The deficiencies of the emerging contractors include the lack of experience in large projects, project proposals lacking the breakdown of tasks, and poor project costing. Besides the prices that deviate far from the reasonable limits, emerging contractors seem to be using outdated project costing methods (i.e. methods no longer used by emerging contractors of developed worlds and large contractors) in business. This article explores the project costing methods used by South African emerging contractors (Nkado, Akintoye, Bowen & Pearl, 1999). The principal aim is to analyse project cost estimation practices, methods and processes utilised by the emerging construction sector in South Africa; identify deficiencies requiring remedial action through development programmes established for emerging contractors, and ultimately establish techniques used by the majority of emerging contractors when estimating tender prices.

2. Estimation

Estimation is the engineering art of developing an informed (or scientific) prediction about the cost and delivery date, and establishing all the resources required by the project (Kemp, 2004: 328; Steyn, Basson, Carruthers, Du Plessis, Prozesky-Kuscke, Kruger, Van Eck & Visser, 2006: 173). Cost estimates are used to evaluate the economic feasibility of projects, evaluate project alternatives, and establish the budget and cost control mechanism (Scott &

Amos, 2007: 9). Clark & Lorenzoni (1997: 11) cite a definition of cost engineering by the American Association of Cost Engineers (AACE) as the area of engineering practice where engineering judgement and experiences are used in the application of scientific principles and techniques to the problems of cost estimation, cost control and profitability. Therefore, estimation is a prediction of the quantity of resources needed to accomplish an activity or create an asset.

There is consensus (Clark & Lorenzoni, 1997; Kemp, 2004; Steyn *et al.*, 2006; Scott & Amos, 2007) that a sound estimate depends on the following building blocks:

- a well-defined scope (what we are trying to estimate);
- a cost element structure (how information is organised), and
- historical cost data (data from cost accounting records and/or experience of knowledgeable people).

Heinze (1996: 225) also mentions the four categories of estimates used based on work scope and/or available information as:

- the quickie (guesstimate, back of a match-box, while on the phone);
- the concept (preliminary, study, order-of-magnitude, factored);
- the budget (official, the approval), and
- the definitive (final, control, firm, detailed, hard bid, take-off, and so on).

The choice of estimating method depends on several factors including the end-use of the estimate, the amount of time and money available to prepare the estimate, estimating tools and data available, the level of project definition, design information available, and the timing or phase of the project.

Clough & Sears (1999: 27) explain that several persons are involved in the initial and ultimate pricing stages as the term 'estimator' refers to all persons involved with the estimating function. An estimate is valid only if the basis for preparing it is also valid (Heinze, 1996: 226; Scott & Amos, 2007; Kul & Uppal, 2008: 1). Thus, the validity and reliability of the estimate depends on the knowledge and experience of the estimator together with a good performance record that inculcates confidence in the estimate. Fuller & Kahn (2003: 147) state that the estimators use the same basic skills, but that actual methods and job descriptions vary widely according to contractors. The estimator's roles and responsibilities are perceived to be planning and review of specifications; compiling data for operations; researching potential

jobs; site study; negotiations; meetings with field team, and value engineering.

2.1 Project cost estimation

The project cost process considers the different project life cycle phases until the final design is completed and the Bill of Quantities (BoQ) is produced (Clough & Sears, 1999: 19). The BoQ is necessary to start cost estimation. Cost estimates are done for initial estimation to determine the feasibility of a project. Estimates are based on a system of gross unit costing. The unit costs are based on previous work of a similar type and magnitude extrapolated forward in time to reflect the current market conditions, project location and the peculiar character of the envisaged project (Lowe & Skitmore, 1994).

Clough & Sears (1999: 25) list common methods used to determine the order of magnitude costing as:

- cost per function estimates based on expenditure per unit of use;
- square metre cost estimates based on gross floor area;
- index number estimates based on the national price indices;
- cost estimates based on cubic metres per volume capacity;
- parameter costing based on different building components and systems, and
- partial take-off estimates using quantities of major work elements from partially completed designs.

3. Tendering

Nokes & Kelly (2007: 295) define tendering (also known as bidding) as the action of confirming a price offer for specified tasks/activities of a project in the prescribed method to the client and the client appreciates it as a procurement process to acquire products and services from outside the project team. Pricing tools for tendering include pricing strategies, sales and revenues, return on investment (ROI), return on sales (ROS), break-even analysis, and so on. Scott & Amos (2007) conceptualise the pricing process using an input-conversion-output model by defining (and thus replacing) pricing as the tools and techniques. The approach indicates that analytical tools are applied on the inputs to produce usable information at the start, during execution and on completion of the project.

Tender evaluation is explained in terms of:

Validation of estimates: An estimate is a prediction of the expected final cost of a proposed project for a given work scope. Thus, by its nature, an estimate involves assumptions and uncertainties, and is associated with some level of error. This level of error can be correlated to probabilities of over-running or under-running the predicted cost. Consequently, an estimate should be reviewed and validated for any errors prior to it being used for tendering purposes (Clemons, Barnett & Lanier, 2005).

Adjusting estimate: Tendering is done within certain time limits. However, some instances take longer to evaluate the tender, and tender conditions may change in the process. Scott & Amos (2007: 72-78) state that changes in project costs occur for a number of economic reasons. Common cost change concepts include inflation, deflation, escalation, taxation, and currency variation if construction takes place in a globalised environment (the global context excludes the emerging sector due to the small size of projects undertaken by the sector). In addition, a project may be funded, designed and governed by a legal jurisdiction in various countries other than the one in which the project is assembled and delivered.

Estimate accuracy: Cheung, Wong & Skitmore (2008: 349) studied clients' and estimators' tolerance to estimating errors. They found that clients and estimators stressed the importance of giving accurate cost estimates, are risk-averse and tolerate overestimates more than underestimates. Heinze (1996: 226) provided a set of descriptive and qualitative terms according to which an estimate can be assessed, namely terms such as credibility; accuracy; exactness; precision; reliability; tolerance; materiality, and validity.

Tender submission: The end result of the decision to tender is to submit the tender to the client's premises. After effecting the necessary adjustment of the tender price according to the pricing strategies of the contractor, a competitive tender is ready for submission in the prescribed format. The prescribed format to submit tenders is usually found in the invitation to tender (ITT) which normally contains the following details:

- the targeted cidb registration status (grade) of contractors;
- availability of documents and contact details of personnel responsible for receiving tender enquiries;
- the date and venue of pre-tender meeting (briefing session) and whether it is compulsory or not;

- manner of tender submission, i.e. original tender documents, returnable schedules and whether electronic or other forms of submission are acceptable;
- the closing date and the place of submission, and
- the tender validity period from the closing date.

If these requirements are not complied with, the tender may be disqualified.

Negotiating tender contract: As a starting point, negotiations would typically be centred on the offer made by the contractor and counteroffers by the client and are an iterative process until consensus is reached. Acceptance following an offer is an unqualified declaration of intent made by the client, approving the offer without reservation. A typical construction industry contract contains contract clauses relating to general terms and conditions, warrantees or guarantees, breach of contract, remedies, payment valuations certificates and progress payments, contract duration, dispute resolution mechanisms, and specific requirements depending on the form of contract selected by the parties. The preceding discussion implies that negotiators need to have strong commitment to mutual gain, have strong focus on the problem, and generally be clear in communicating the negotiator's viewpoints.

3. Research methodology

A semi-structured questionnaire consisting of six questions, each with several subquestions, was the main research instrument. The questions referred to estimating techniques used by emerging contractors. The questionnaire was distributed to a sample of 161 emerging contractors such as builder, civil, electrical, mechanical and miscellaneous other contractors. The respective sample sizes of each strata were 54 (36.0%), 68 (39.8%), 19 (11.8%), 11 (6.8%) and nine (6.6%).

3.1 Population and sampling

The study population were emerging cidb-registered contractors registered for work up to R5m. The cidb's Contractor Register included 792 such contractors (cidb, 2009). These contractors were further categorised into contractor types or strata: general builders, civil, electrical, mechanical, and others. These strata enabled stratified sampling (Curwin & Slater, 2002). Simple random samples were selected from each stratum. Simple random sampling is a sampling method where items in the research population are uniform and

have an equal probability of being included in the sample (Bless & Kathuria, 1993). To increase accuracy, a 20% sampling ratio was used based on the 10% minimum required, thus targeting 160 (20% = 158.4) of these contractors. The proportional sizes were determined for each stratum, and respective samples were generated using a random generator. The cidb's definition of potentially emerging contractor implies that the contractor organisation is owned mainly by the previously disadvantaged individual/s as a result of the previous government's discriminatory laws. Bouma (2000: 130) advises that at least 30 individual elements are required in order to provide a pool that is large enough for simple kinds of analyses. The respondents were further categorised into provincial locations.

Table 1 summarises the population, sample, and sampling ratios of the various strata, as well as the total sampling ratio.

Table 1: Population, sample, and strata

	General building	*Civil*	*Electrical*	*Mechanical*	*Others*	*Total*
Population	286	316	94	53	43	792
Sample (frequency)	58	64	19	11	9	161
Sample (% of population)	20.28%	20.25%	20.21%	20.75%	20.93%	20.33%

Key: % of population = sample as percentage of category population

From the 792 member population, a stratified sample of 161 respondents (20.3% of the population) participated. Table 2 provides the provincial spread of the contractors.

Table 2: Provincial spread of respondents

	GAU	*KZN*	*NW*	*FS*	*WC*	*NC*	*Mpu*	*EC*	*Lim*
'f'	34	29	14	11	16	8	16	14	19
'%'	12.1%	18.0%	8.7%	6.8%	9.9%	5.0%	9.9%	8.7%	11.8%

Key: 'f' = number/frequency of respondents; '%' = percentage of respondents; GAU = Gauteng; KZN = KwaZulu-Natal; NW = North-West; WC = Western Cape; NC = Northern Cape; Mpu = Mpumalanga; EC = Eastern Cape; Lim = Limpopo

4. Findings

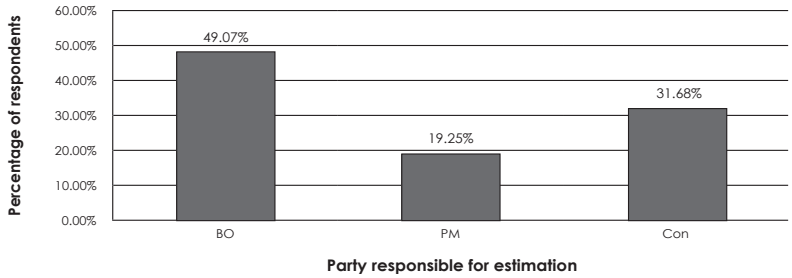
4.1 Proposal management and estimating team

Table 3 presents the emerging contractors' distribution according to frequencies of responsibility for managing proposal and estimating among the role players (business owner, project manager and consultant) involved when the emerging contractors prepare tender documents.

Table 3: Responsibility for proposal management

	Building	*Civil*	*Electrical*	*Mechanical*	*Other forms*	*Total*
Business owner	38	23	12	4	2	79
Project manager	7	15	3	3	3	31
Consultant	13	26	4	4	4	51
Total	58	64	19	11	9	161
%	36.12%	39.75%	11.80%	6.83%	5.59%	100

Table 4: Responsibility for estimation



Key: BO = business owner; PM = project manager; Con = consultant

The research sample consisted of 58 (36.0%) general builders, 64 (39.7%) civil engineers, 19 (11.8%) electricians, 11 (6.8%) mechanical engineers, and 9 (5.6%) other/sundry contractors. Business owners, project managers and consultants were responsible for the estimation, at 49.1%, 19.2% and 31.7%, respectively. Interest arises to test whether the responsibility in proposal management and estimation and the contractor type are dependent. The null hypothesis is H_0: project management responsibility in the emerging contractor sector depends on the type of emerging contractor.

Due to a few observed frequencies, the Yates corrected *chi*-square (Bless & Kathuria, 1993: 192) is used, namely:

$$\chi^2 = \sum_{i=1}^{k} \frac{\left(\left|o_{ij} - e_j\right| - 0.5\right)^2}{e_j}$$

where, O_{ij} are the observed frequencies and e_{ij} the expected frequencies of the emerging contractors based on the null hypothesis. All the tests were conducted at the 5% level of significance to determine whether the estimation methods used by emerging contractors were due to an existing pattern or occurred randomly.

Table 5: Expected responsibility for proposal management

	Building	*Civil*	*Electrical*	*Mechanical*	*Other forms*
Business owner	28.4596	31.4037	9.3230	5.3975	4.4161
Project manager	11.1677	12.3230	3.6584	2.1180	1.7329
Consultant	18.3727	20.2733	6.0186	3.4845	2.8509

Calculation of *chi*-square statistic gives χ^2 = 11.5252. The degrees of freedom (d.f.) for this contingency table is (rows – 1)(columns – 1) = (2)(4) = 8. At the 5% level of significance the critical value is 16.919. Since the test statistic does not exceed the critical region, the null hypothesis of independence cannot be rejected. Thus, at the 5% level of significance there is no statistical evidence that estimation approach depends on the type of contractor. This means that there is no attachment of proposal management and estimation to a type of role played during estimation when tendering in the emerging contractor sector.

Table 6: Responsibility for proposal management per province: observed

	GAU	*KZN*	*NW*	*FS*	*WC*	*NC*	*Mpu*	*EC*	*Lim*	*Total*
BO	25	12	11	7	3	5	1	10	3	79
PM	4	5	1	1	7	2	5	2	5	31
Con	5	12	2	3	6	1	9	2	11	51
Total	34	29	14	11	16	8	16	14	19	161

Table 7: Responsibility for proposal management per province: expected

	GAU	*KZN*	*NW*	*FS*	*WC*	*NC*	*Mpu*	*EC*	*Lim*
BO	16.683	14.230	6.870	5.397	7.851	3.926	7.851	6.870	9.323
PM	6.547	5.584	2.696	2.118	3.081	1.540	3.081	2.696	3.658
Con	10.770	9.186	4.435	3.485	5.068	2.534	5.068	4.435	6.019

Chi-square $\chi^2 = 35.2519$ with d.f. = (2) (8) = 16. The critical value is 26.296. The test statistic exceeds this critical value, leading to the rejection of the null hypothesis of independence. Thus, at the 5% significance level there is enough statistical evidence that estimation methods used by emerging contractors depend on the province in which the contractor is located. Therefore, the emerging contractors in the different provinces vary with respect to the estimation methods they use in tendering.

Table 8 displays the distribution of the observed frequencies of the professional backgrounds of the various emerging contractor sector role players.

Table 8: Professional background of estimator versus responsibility: observed

	Engineer	*Quantity surveyor*	*Architect*	*Accountant*	*OD*	*IP*	*Stat/ Econ*	*Total*
BO	7	17	1	1	27	31	4	79
PM	7	1	5	1	7	9	1	31
Con	1	13	2	3	11	14	7	51
Total	15	31	8	5	45	54	12	161

Table 9 displays the expected frequencies based on Table 8 with the hypothesis that the professional backgrounds of emerging contractors do not influence the type of role played by emerging contractors in tendering.

Table 9: Professional background of estimator versus responsibility: expected

	Engineer	*Quantity surveyor*	*Architect*	*Accountant*	*OD*	*IP*	*Stat/ Econ*
BO	7.3602	15.2112	3.9255	2.4534	22.0807	26.4969	5.8882
PM	2.8882	5.9689	1.5404	0.9627	8.6646	10.3975	2.3106
Con	4.7516	9.8199	2.5342	1.5839	14.2547	17.1056	3.8012

Chi-square χ^2 = 24.41964 with d.f. = (2)(6) = 12. The critical value is 21.026. The test statistic exceeds the critical value, resulting in rejecting the null hypothesis of independence. Hence, at the 5% level of significance there is enough statistical evidence that the role players used by the emerging contractors depend on the professional background of the contractor. This means that the professional backgrounds of emerging contractors influence the type of role player involved in estimating when tendering.

4.2 Programming and scheduling techniques

Table 10 displays the distribution of the observed frequencies of programming and scheduling techniques used against the various role players in the emerging contractor sector.

Table 10: Use of programmes versus responsibility for proposal management and estimation: observed

	CPM	*PERT*	*Charts*	*WBS*	*Other forms*	*Total*
BO	0	3	54	21	1	79
PM	1	0	19	2	9	31
Con	1	2	28	19	1	51
Total	2	5	101	42	11	161

Table 11 displays the expected frequencies based on Table 10 with the hypothesis that the programming and scheduling techniques in the emerging contractor sector do not influence the type of role played by emerging contractors in tendering.

Table 11: Use of programmes vs. responsibility for *proposal management and estimation*: expected

	CPM	*PERT*	*Charts*	*WBS*	*Other forms*
BO	0.9814	2.4534	49.5590	20.6087	5.3975
PM	0.3851	0.9627	19.4472	8.0870	2.1180
Con	0.6335	1.5839	31.9938	13.3043	3.4845

Chi-square χ^2 = 30.285498 with d.f. = (2)(4) = 8. The critical value is 26.296, which is lower than the test statistic, leading to rejecting the null hypothesis of independence. Thus, at the 5% significance level there is enough statistical evidence that the, use of programming technique in the emerging contractor sector depends on the professional background of the contractor.

4.3 Project risk management

Table 12 displays the distribution of the observed frequencies of project risk management used against the various role players in the emerging contractor sector.

Table 12: Use of project risk management versus responsibility: observed

	Internal document analysis	*Checklist analysis*	*Assumptions and analysis*	*Total*
BO	1	4	74	79
PM	3	13	15	31
Con	2	8	41	51
Total	6	25	130	161

Table 13 displays the expected frequencies based on Table 12 with the hypothesis that project risk management in the emerging contractor sector does not influence the type of role played by emerging contractors in tendering.

Table 13: Use of project risk management versus responsibility: expected

	Internal document analysis	*Checklist analysis*	*Assumptions and analysis*
BO	2.9441	12.2671	63.7888
PM	1.1553	4.8137	25.0311
Con	1.9006	7.9193	41.1801

Chi-square x^2 = 461.7588 with d.f. = (2)(2) = 4. The critical value is 9.488. The test statistic exceeds the critical value, and results in the rejection of the null hypothesis of independence. It is concluded that at the 5% level of significance there is enough statistical evidence that the use of project management risk approach and responsibility for proposal management and estimation in the emerging contractor sector are dependent.

Table 14 displays the distribution of the observed frequencies of risk allocation strategies used against the various role players in the emerging contractor sector.

Table 14: Use of project risk allocation strategies: observed

	Risk transfer	*Risk reduction*	*Risk retention*	*Risk elimination*	*Risk sharing*	*Total*
BO	7	66	1	1	4	79
PM	7	13	1	2	8	31
Con	17	14	2	4	14	51
Total	31	93	4	7	26	161

Table 15 displays the expected frequencies based on Table 14 with the hypothesis that risk allocation strategies in the emerging contractor sector do not influence the type of role played by emerging contractors in tendering.

Table 15: Use of project risk allocation strategies: expected

	Risk transfer	*Risk reduction*	*Risk retention*	*Risk elimination*	*Risk sharing*
BO	15.2112	45.6335	1.9627	3.4348	12.7578
PM	5.9689	17.9068	0.7702	1.3478	5.0062
Con	9.8199	29.4596	1.2671	2.2174	8.2360

Chi-square x^2 = 37.87779 with d.f. = (2)(4) = 8. The critical value is 15.507. The test statistic exceeds the critical value, and the null hypothesis of independence is rejected. Thus, at the 5% significance level there is no enough statistical evidence that the use of project risk allocation and responsibility for estimation in the emerging contractor sector are dependent.

4.4 Pre-tender internal price evaluation

Table 16 displays the distribution of the observed frequencies of pre-tender internal price evaluation used against the various role players in the emerging contractor sector. Table 17 displays the expected frequencies based on Table 16 with the hypothesis that pre-tender internal price evaluation in the emerging contractor sector does not influence the type of role play in tendering.

Table 16: Pre-tender internal price evaluation versus responsibility: observed

	Over-price	*Under-price*	*Balance price*	*Total*
BO	6	4	69	79
PM	2	2	27	31
Con	3	11	37	51
Total	11	17	133	161

Table 17: Pre-tender internal price evaluation versus responsibility: expected

	Over-price	*Under-price*	*Balance price*
BO	5.3975	8.3416	65.2609
PM	2.1180	3.2733	25.6087
Con	3.4845	5.3851	42.1304

Chi-square χ^2 = 7.58178 with d.f. = (2)(2) = 4. The critical value is 9.488. The test statistic does not exceed the critical value. The null hypothesis of independence is therefore not rejected. The conclusion is that at the 5% level of significance there is enough statistical evidence that among the emerging contractors, the use of project management risk approach does not have any bearing on the person responsible for estimating.

5. Results and discussions

This section presents the research results. This is followed by a discussion of the results and the conclusion.

5.1 Proposal management and estimating team

In South Africa's emerging contractor sector, civil engineers dominated the contractors, followed by general builders, mechanical engineers, electricians and, lastly, a mix of other types of contractors. Proposal management and estimation were dominated by business owners, then project managers and, lastly, consultants. Since estimation approach was found to be dependent on the type of contractor, this implies that different contractors approached estimation differently. It was similarly shown that different contractors approached estimation and proposal management differently according to province. Professional backgrounds of different contractors also influenced the way in which the contractors managed proposals and conducted their estimation of projects.

5.2 Programming and scheduling techniques

The study revealed that programming and scheduling techniques used by the various emerging contractors were associated with the way in which the emerging contractors managed proposals and conducted their estimation of projects.

5.3 Project risk management

The study showed that, in the emerging contractor sector, use of project risk management approach and responsibility for proposal management and estimation are dependent.

5.4 Pre-tender internal price evaluation

The study showed that, in the emerging contractor sector, use of pre-tender internal price evaluation also influenced the responsibility to manage proposal and estimation approaches.

6. Conclusions

This section concludes the research by pointing at three salient findings regarding the main concerns of this research, and provides the recommendations from the study.

6.1 Role playing to estimate tender prices

Through analyses and tests conducted, empirical evidence shows that, in the emerging contractor sector:

- the responsibility of estimating tender prices is linked to and dependent on the principal trading area/s. General building

and electrical contractors prefer to take responsibility for price estimation whereas the combined enterprise formations usually outsource the responsibility to consultants, and

- the majority of emerging contractors have technical skills whereas few of them outsource to persons with quantity surveying skills and even fewer to civil engineers.

6.2 General practices to estimate tender prices

- The majority of emerging contractors make use of the Gantt chart programming and scheduling technique. Fewer use the WBS method. The more complex CPM and PERT methods are virtually not used, i.e., they are used to an insignificant extent relative to the use of other methods. Generally though, relative to the methods applied in the construction industry in South Africa, project costs estimates developed by emerging contractors are questionable.
- Cost drivers such as labour, materials, plant and equipment are highly recognised in the tender compilation.
- The emerging contractor sector seems to have high awareness of risk factors but seems to lack the capability to manage risk.

6.3 Compliance to best practice

Since leading nations use complex methods which the emerging construction sector in South Africa did not use, it is evident that this sector does not meet global best practice standards. There is no doubt that this is caused by the lack of skills and resources necessary to meet global best practice.

7. Recommendations

The estimation practices of not following benchmarked standards and depending on the poor condition (such as lack of skill and knowledge) of the contractors require intervention to remedy the sector's plight. It is generally recommended that the remedial action should focus on proposal and procurement management, project cost management, and project risk management. Specific recommendations are discussed below.

7.1 Responsibility to estimate tender prices

Emerging contractors mainly lack technical skills and enter the market with limited exposure and resources, whereas consultants seem to be able to improve the emerging business in building and construction. Therefore, in order to enhance their competitiveness and sustainability, it is recommended that:

- they volunteer to work under consultants in order to acquire the skills used by consultants on outsourced work, and that
- emerging contractors who do not have technical skills should never tender as main contactors, but should subcontract or partner with companies that have the skills and resources.

7.2 Practices to estimate tender prices

If the emerging contractors use simpler estimation methods while their established competitors use complex ones, emerging contractors will likely not be perceived as competitive. It is therefore recommended that:

- the emerging contractors should emulate leading local contractors to familiarise themselves with the environment;
- they should be 'interns' or subcontractors of established contractors in order to learn to use complex methods quickly and simpler scheduling techniques independently to verify the results of the complex ones. (In this way they ask to be mentored and, in return, give their time.), and that
- they should learn about project risks and methods to manage risks to eliminate or minimise their impact.

7.3 Compliance to best practice

It is recommended that the emerging South African contractors should follow niche business and/or subcontract to established contractors for skills acquisition and avoid direct and immediate competition until they have reached a stage where they can perform at a higher level. When they have acquired the main basic skills to practise methods used by leading competitors to raise their standards to competitive levels, gained experience and established their client base adequately, then they can start participating independently, but rather on a low scale. They should learn the trade during their subcontracts from established contractors. In their early existence they should avoid exerting themselves aggressively and independently against established contractors.

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