ACCURACY OF COST ENGINEERS' BUILDING PRICE FORECASTS IN SOUTH AFRICA

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INTRODUCTION

Quantity surveyors, the consultants who undertake the cost engineering function within the South African building industry, have traditionally undertaken the building price forecasting function as an integral part of the package of services offered by them to building clients. Given that the main functions of price forecasting include providing the client with an indication of anticipated financial commitment and servicing the information needs of the design function, it is necessary to establish the accuracy of building price forecasts. This, of necessity, must be assessed in terms of the accuracy expectations of the receivers of price forecasts, namely, architects and clients.

This paper is divided into two main parts. The first section documents the results of a national questionnaire survey (Bowen, 1993) undertaken to establish, *inter alia*, the importance to recipients of accurate building price forecasts, levels of accuracy *expected and received* by clients and architects, and quantity surveyors' *perceptions* of their own ability to accurately forecast prices. More specifically, the opinions of quantity surveyors, architects and clients were sought by means of a detailed questionnaire survey involving a total of 2010 questionnaires: quantity surveyors (496); architects (1115); and clients (399). The response rates were 20%, 10% and 31%, respectively. The analysis of the questionnaires is conducted in terms of the process of design from inception to tender.

The second part of the paper focuses on the levels of price forecasting accuracy *actually achieved* by quantity surveyors in practice. An empirical study (Pearl, 1992), involving an analysis of 243 projects undertaken by 30 quantity surveying practices in the Western Cape in the period 1982 - 1991, is documented. More specifically, the study concerned the accuracy of quantity surveyors' pre-tender price forecasts

(pricing bills of quantities) compared to the lowest (accepted) tender.

FORECASTING ACCURACY ACHIEVABLE IN THEORY

In this section the accuracy *theoretically achievable* by quantity surveyors in the provision of price forecasts is introduced.

Bowen and Edwards (1985) drew attention to the need to establish `acceptable' levels of accuracy in the context of the provision of price forecasts and price plans. Skitmore *et al*. (1990), in a detailed study of the quality of price forecasts in the United Kingdom, state that the quality of any price forecast is a function of five factors, namely: the nature of the target (e.g., the nature, type and size of the project); the information used; the forecasting technique utilised; the feedback mechanism employed; and the person providing the forecast. Very little research effort has been focused on the question of price forecasting quality. The major contributions have emanated from Ashworth and Skitmore (1982, 1986), Flanagan and Norman (1983), Morrison (1984) and Skitmore *et al*. (1990), with Skitmore (1985) investigating the influence of professional expertise on construction price forecasts.

The issue of `accuracy' is confounded when it is appreciated that neither the price forecast by the quantity surveyor nor the bid submitted by the contractor are `true' values, both being forecasts and hence subject to relative error bounds. In fact, three points are of relevance here: the accuracy of the tender price submitted by the contractor; the accuracy of the price forecast made by the quantity surveyor; and the `true' price. Moreover, errors in the measurement of physical *quanta* will be present (Heisenberg, 1967), and need not be insignificant (Edwards *et al*., 1990).

Bowen and Edwards (1985) point to the possible divergence between expectations of accuracy on the part of clients and architects on the one hand, and assumptions of accuracy by the quantity surveyor on the other hand. Cursory research (Bowen

and Edwards, 1985) indicated that this is indeed so. Flanagan (1980) called for the introduction of accuracy monitoring systems utilising techniques borrowed from statistics, for example, *cusum charts*.

Possibly the most seminal work into price forecasting accuracy has been produced by Beeston (1975, 1983) who, in a theoretical analysis, concluded that a coefficient of variation of 7% for the quantity surveyors' observable estimating variability is the performance which can be expected using present methods in the best way under average circumstances. Morrison (1983), in a study of 915 projects taken from seven different quantity surveyors' offices, revealed that the average accuracy achieved by quantity surveyors when pricing bills of quantities has a mean deviation of approximately 12% and coefficient of variation of approximately 16%. Morrison (1983) suggested that the use of a less detailed method of forecasting, such as the elemental method, is likely to produce results with a coefficient of variation of approximately 20%. All the above publications relate to studies undertaken in the United Kingdom.

No evidence, apart from a very cursory study undertaken by Bowen and Edwards (1985), Pearl (1992) and Bowen (1993), could be found in the literature relating to research concerning the accuracy of quantity surveyors' price forecasts in South Africa.

The following sections deal with the importance of accurate building price forecasts; an assessment of accuracy levels expected and received in price forecasting; and an empirical study of the accuracy of price forecasts provided by quantity surveyors.

THE IMPORTANCE OF ACCURATE PRICE FORECASTS

Given the *raison d'etre* of price forecasting, it is necessary to establish the importance placed on accurate building price forecasts by the recipients of those forecasts.

When asked whether or not they would be perturbed if presented with inaccurate price forecasts, 99% of clients and 98% of architects replied in the affirmative. Insofar as the main consequences to clients and architects of receiving *inaccurate price forecasts* are concerned, clients cited the shelving of the project, financial loss, lower than anticipated return on investment, and deviations from the budget. Architects cited the termination of the project, the possible loss of a client, a poor relationship with the client and the payment of professional fees being jeopardised, as the main possible consequences.

The importance of accurate price forecasts is emphasised by the fact that 76% of clients claim that building price *per se* typically accounts for more than fifty per cent of total project development expenditure. In fact, 87% of clients state that building price normally exceeds forty per cent of total project expenditure. *In summary, clients and architects are emphatic regarding their need for accurate building price forecasts*.

QUANTITY SURVEYORS' PERCEPTIONS OF ACCURACY ACHIEVABLE

Bowen (1993) established that quantity surveyors have clear preferences for certain price forecasting methodologies at the various stages of the design process. More specifically, it was concluded that practitioners have a preference for the superficial method of price forecasting during the inception stage; for the approximate quantities and elemental methods at the appraisal, design concept and design development stages; and for pricing bills of quantities at the documentation stage. Given the price forecasting method preferences of practitioners at the various stages of design, and the perceived levels (by quantity surveyors) of accuracy of these models, insight can be gained into the accuracy levels that quantity surveyors expect to achieve at the various design stages. In essence, *quantity surveyors are of the* ***opinion*** *that accuracy can be expected to be within 17% at the inception stage, within 9% at the appraisal, design concept and design development stages, and within 5% at the documentation stage*.

Table 1 reflects the opinions of quantity surveyors regarding the expected accuracy levels of price forecasts (ignoring the price forecasting method used) produced at the various stages of design, relative to the lowest (accepted) tender. These assessments of accuracy are categorised as `best', `average' and `worst'.

Using the average expected level of accuracy for each stage, the results depicted in Table 1 do not conflict with the levels of mean expected accuracy `derived' above. As might be expected, both the relative magnitude of accuracy levels and accuracy ranges diminish as the design progresses.

Table 1 Quantity surveyors' assessment of the accuracy of price forecasts produced at the various stages of the design process (Bowen, 1993)

Design stage	Mean expected level of accuracy		
	Best	Average	Worst
	(%)	(%)	(%)
Inception	8	14	22
Appraisal	5	10	16
Design concept	5	9	13
Design development	3	6	11
Documentation	3	5	9

Interestingly, Pearl (1992), in an empirical study involving a national questionnaire survey of 498 quantity surveyors, obtained similar results to those described above. Of the 234 respondents, 71.2% indicated that they expected forecasts compiled at the documentation stage to be within 5% of the accepted bid. A further 27.2% of the respondents expected forecasts produced at this stage to be within a 6% to 10% range of the approved tender. A small number of respondents (1.6%) suggested that documentation stage price forecasts could be expected to vary from the lowest tender by more than 10%.

ARCHITECTS' AND CLIENTS' EXPECTATIONS OF ACCURACY

The importance of price forecasts to clients and architects has been established, as has the fact that the overwhelming majority of the recipients of price forecasts would be perturbed if presented with an inaccurate price forecast. Thus, it seems prudent to determine the levels of accuracy that clients and architects expect from price forecasters at the various stages of design, as well as their *perceptions* of the levels of accuracy actually received. Table 2 depicts these results in absolute form.

A possible reason for the differences of opinion between the respondents may be because the intention behind this question may have been unclear. More specifically, the intention was to elicit the level of accuracy *required* by the recipients of price advice, rather than that *expected* by respondents. Since expectations are based on previous experience, respondents to this question may have understood this question to mean the level of accuracy which would be expected from a quantity surveyor based on previous experience, and not necessarily the level of accuracy clients and architects would like to receive. This *caveat* should be borne in mind when examining the results.

It appears that clients *require* greater levels of accuracy at the *inception* stage than do architects. More specifically, this is illustrated by the fact that 61% of clients report accuracy requirements to within 10% (83% to within 15%), but only 35% claim to actually receive this level of accuracy (76% to within 15%). Conversely, the accuracy requirements of architects are generally met, with 21% requiring accuracy levels to within 10% (69% within 15%) and 25% claiming to receive this level of accuracy (70% to within 15%). Consequently, whereas the majority of clients expect accuracy in the 6 - 10% range, and receive accuracy within the 11 - 15% range, the majority of architects expect and receive accuracy in the 11 - 15% range. These findings accord with those of quantity surveyors (see Table 1), where the mean expected level of accuracy in `average' situations is perceived to be within 14% of the lowest tender.

Again, at *appraisal* stage, clients appear to possess higher expectations of accuracy than do architects. Nearly 50% of clients expect accuracy levels to within 5% at this stage, but only 16% claim to receive this level of accuracy. The single largest group of clients (51%) report accuracy levels in the range of 6 - 10%. Conversely, only 14% of architects expect accuracy to within 5%, with 8% of them claiming to receive such accuracy. The received accuracy range enjoying the greatest support among architects (38%) is that of 11 - 15%. These opinions are consistent with the response of quantity surveyors who affirm that, on average, a mean expected

accuracy level of within 10% is provided at this stage.

Table 2 Client and architect assessment of (absolute) accuracy levels required and received at the various stages of design (Bowen, 1993)

	Frequency of occurrence											
	0 - 5%		6 - 10%		11 - 15%		16 - 20%		21 - 25%		Exc. 25%	
	Client	Architect	Client	Architect	Client	Architect	Client	Architect	Client	Architect	Client	Architect
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
EXPECTED												
Inception	14	5	47	16	22	48	12	25	1	1	5	5
Appraisal	49	14	31	31	14	44	1	7	1	3	5	1
Design concept	53	20	34	53	8	24	1	0	1	2	4	1
Design development	77	46	14	46	3	6	0	1	0	0	6	1
Documentation	86	72	9	23	1	5	0	0	0	0	4	1
RECEIVED												
Inception	9	3	26	22	41	45	6	19	11	7	8	5
Appraisal	16	8	51	33	20	38	6	12	3	5	6	4
Design concept	23	11	46	42	20	34	4	10	4	2	4	1
Design development	42	23	41	52	7	20	5	4	0	0	5	1
Documentation	46	35	41	54	6	7	2	3	0	0	5	1

At the *design concept* stage, the majority of clients (53%) expect price advice accurate to within 5%, whereas the majority of architects (53%) expect it in the 6 - 10% range. The single largest groups of clients and architects (46% and 42%, respectively) report receiving accuracy levels in the 6 - 10% range. This claim is reinforced by quantity surveyors who believe that, on average, a mean expected accuracy level of within 9% is achieved (see Table 1).

At the *design development* stage, the majority of clients (77%) require accuracy to within 5%, compared with only 46% of architects desiring the same level of accuracy. A further 46% of architects require accuracy in the 6 - 10% range. As far as levels of accuracy received is concerned, clients appear to be somewhat equally divided in their opinions, with 42% claiming to receive accuracy to within 5% and a further 41% reporting accuracy in the 6 - 10% range. Conversely, 23% of architects state that accuracy levels received are within 5%, whilst a further 52% (the single largest group) claim that accuracy in the 6 - 10% range is received. Interestingly, the mean expected accuracy level achieved (in the opinion of quantity surveyors) at this stage of the design process is, in average situations, within 6%.

The accuracy expectations of both clients and architects appear to be unfulfilled at the *documentation* stage. More specifically, 86% of clients and 72% of architects expect accuracy levels to be within 5%, but only 46% of clients and 35% of architects claim to receive such accuracy. Indeed, 41% of clients and 54% of architects report receiving accuracy levels in the 6 - 10% range at this stage. These results conflict with the opinions of quantity surveyors, where the mean expected accuracy level is typically to within 5%.

To summarise, the majority of clients and architects consider price forecasts to be important, especially given that the price of buildings very often exceeds 50% of total project development expenditure. Both clients' and architects' expectations of accuracy increase over the various stages of the design process, as does the reported level of accuracy received, but not to the same extent. Indeed, clients'

expectations of accuracy are consistently higher than those of architects, at all stages of the design process. Furthermore, more clients than architects report receiving higher levels of accuracy, albeit at lower levels than that expected.

In the following section the validity of the opinions expressed above are tested by analysing the price forecasting performance of quantity surveyors on a large sample of building projects undertaken in the Western Cape.

EMPIRICAL STUDY OF FORECASTING ACCURACY ACTUALLY ACHIEVED

An overview of the general characteristics of the sample of 243 price forecasts examined in the empirical study is given in Table 3. This table reflects the nett absolute accuracy levels of forecasts produced (the unit of measurement referred to in the first part of this paper), in addition to certain alternative measures used by researchers and practitioners for measuring the accuracy or consistency of price forecasts.

Table 3 Measures of accuracy recorded within nett accuracy ranges (Pearl, 1992)

Measure	Nett Accuracy Ranges				
	0 - 5%	6 - 10%	11 - 15%	16 - 20%	EXC 20%
Nett Accuracy (Mean)	2.13	6.97	12.54	17.27	41.49
Estimators Nett CV	4.57	9.23	24.52	20.96	81.65
Bidders CV	5.29	5.13	4.32	5.86	7.10
Fixed Sums Allowance	20.00	21.59	22.51	22.69	26.47

A particularly illuminating aspect of the study is the performance of individual firms and their influence on the results of the survey. Of the 30 firms contributing to the study, only 6 submitted details on more than 14 projects. This is partly due to the lack of adequate records, but more significantly, a reflection of the composition of quantity surveying practices - the available work being distributed amongst a large number of small firms.

Of the 6 larger practices, half portray a satisfactory level of performance, both in terms of mean nett absolute deviation from the low bid and CV (measuring consistency). Of the other 3 firms, two reflect acceptable mean nett accuracy figures (below 10%), but suffer from inconsistent performance.

The remaining firm of the six firms under discussion submitted details on 25 projects, displaying an average nett accuracy of only 31.16%, with a CV level of 99.96%. As could be anticipated from the above statistics, only 6 of the listed projects are forecast to within 10% accuracy. This firm's forecasts are generally high (16.9% mean relative deviation from the low bid), the highest deviation being 105.67% above the accepted tender. Even if the effect of allowing for the deduction of `fixed sums' is ignored, the performance displayed by this firm appears to be far below that previously described as an acceptable standard. There is no obvious reason for the above error margin, the only noticeable feature of the sample being a higher than usual number of tenderers (11, compared with the norm of 8.)

As the projects submitted by this firm constitute approximately 10% of the total sample, a study of the effect that the omission of these data have on the survey results was conducted. The mean accuracy of the remaining projects improves to 9.67% (on the outer fringe of the expected range), but improvement in the coefficient of variation is less discernible at 43.93%.

Although the mean results indicate general performance levels below that desired (almost a quarter of the firms consistently producing forecasts which are inaccurate), it should be noted that half of the participating firms achieved satisfactory results both in terms of accuracy and consistency. Four of the 30 firms are considered to be producing work of an inadequate nature, being poorer than the established norm in terms of both accuracy and consistency.

It appears unlikely that price forecasters base their expectations of forecasting accuracy on the `nett' amounts (i.e., after adjustment for fixed sums). This is considered a major reason for the suggested propensity of forecasters to be over-optimistic in the evaluation of their forecasting skills.

The details in Table 3 facilitate a comparison between the forecasting consistency achieved by price forecasters (estimators CV) and the variability of tenders about the mean bid on individual projects (bidders CV). It is recognised that, although the two measures are not directly comparable, the trends displayed by the analysis indicate that the consistency achieved by the professional consultants is far more variable than that of contractors compiling individual tenders.

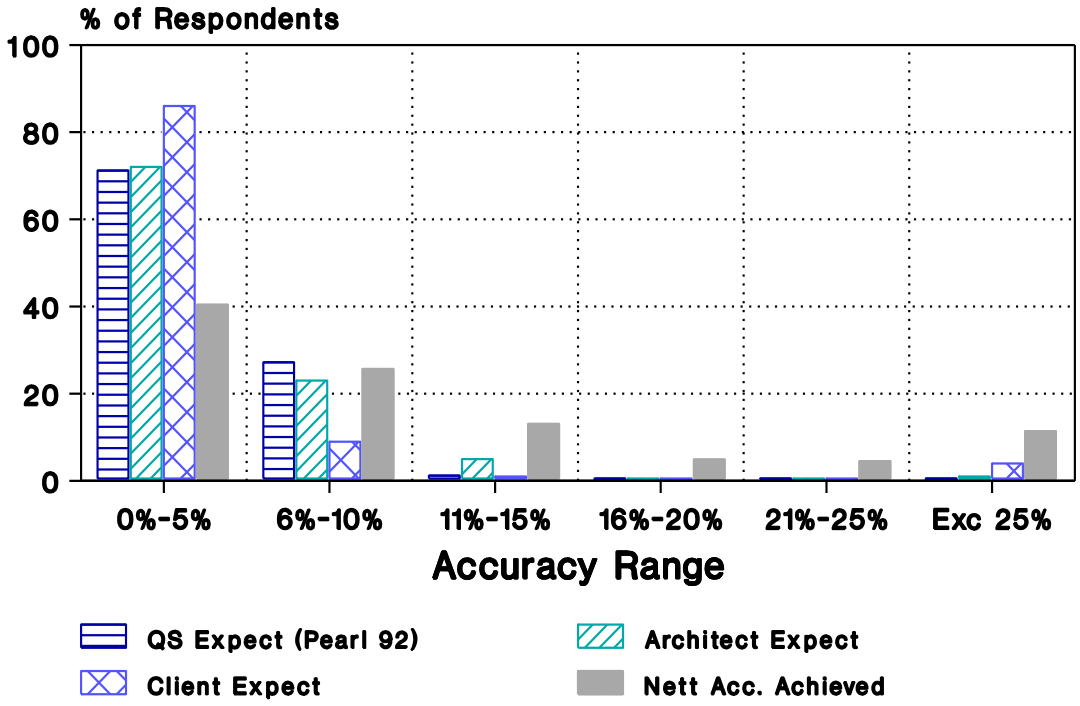
Notable features associated with the range of projects exhibiting the poorest estimating accuracy are: (a) a high number of bidders; (b) higher than average project values; (c) greater variability than usual in terms of tenderers' bidding range and CV of bids; and (d) a large percentage of the tender amount comprising fixed sums.

The results of the empirical study indicate that only 76% of consultants' forecasts are within 10% of the accepted tender. Moreover, the mean nett absolute accuracy actually achieved is outside the 0 - 10% range; being 11.84% of the lowest tender. A further aspect of the empirical survey is that the average consistency achieved (CV value) is 49.85%, compared to the international norm of 12% - 19%. These statistics indicate that there is a distinct disparity between what forecasters perceive they achieve in terms of the accuracy of their forecasts, and actual performance.

Only 40.4% of the projects tested in the empirical study were within 5% of the accepted tender amounts, whilst a further 25.7% fell within the category of 6% to 10% deviation from the bid. Of the other categories: (a) 13.1% of the forecasts were between 11% and 15% deviation; (b) 4.9% were categorised as between 16% and 20%; (c) 4.5% of forecasts were in excess of 21% but less than 25% deviation; and (d) 11.4% of project forecasts differed from the accepted tender by more than 25%.

The necessity of satisfying the needs of clients and architects in respect of the provision of consistently accurate price forecasts has been described elsewhere in this paper. Thus, it is expedient to ascertain the extent to which

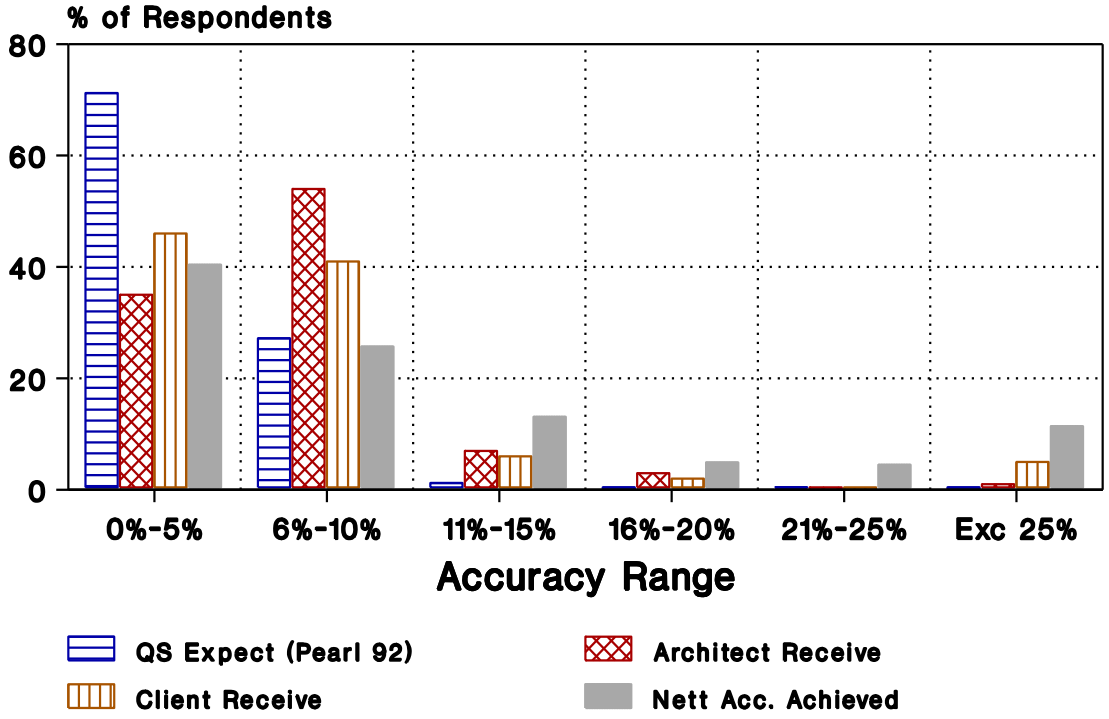
these parties' needs are met in practice. Figure 1 depicts the comparison of the mean nett accuracy levels of the projects examined in the empirical study (Pearl, 1992) with the expectations of the parties (Bowen, 1993) as described in an earlier section. It is evident that the price forecasting accuracy actually achieved falls short of what is expected by clients and architects, as well as being inferior to the



expected performance levels of price forecasters themselves.

Figure 1 Comparison of actual performance with expectations

A further analysis, comparing the actual results of the empirical study (Pearl, 1992) with what architects and clients



say is achieved (Bowen, 1993), is presented in Figure 2.

Figure 2 Comparison of actual forecasting performance with assessment of achievements

The forecasting performance actually achieved, as measured in the empirical study, is generally inferior to the accuracy that clients and architects feel is provided. This is considered to be of particular importance, given the concern expressed by architects and clients regarding the accuracy levels they perceive to be achieved. The number of price forecasts deviating from the accepted tender by more than 10% is notably higher than that anticipated.

Whilst it could be argued that the expectations of architects and clients in respect of the achievable levels of forecasting accuracy are unrealistically high if international price forecasting standards are used as a measure, the performance actually measured in the empirical study gives cause for concern. The results indicate that a large number of South African price forecasters produce price forecasts that are inaccurate and / or inconsistent in terms of accuracy.

CONCLUSION

In the first part of this paper, clients and architects responding to a national questionnaire survey indicated that they regard the provision of accurate building price forecasts to constitute a vital service. It was felt, however, that the accuracy levels actually achieved by South African price forecasters were below the expected standard.

Quantity surveyors producing such forecasts indicated however, that the levels of accuracy expected by architects and clients were being achieved. Thus a perception `gap' appears to exist.

The results of an empirical study of quantity surveyors' forecasting accuracy described in the second part of this paper confirm that price forecasts being provided do not meet the expected standards of clients or architects or even quantity surveyors themselves. In addition, the observed

accuracy of price forecasts has been found to be inferior to that reported by clients and architects.

The need for South African price forecasters to improve price forecasting accuracy, in addressing the needs of recipients of forecasts, is clearly demonstrated.

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