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The development of location adjustment factors for construction price estimating in Nigeria

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Abstract

This article explored the use of Location Factors (LFs) as an empirical tool for converting construction price at one location to price at another location. The objective was to generate LFs for selected locations to provoke interest in the concept. Firstly, locational factors influencing construction price were identified from literature. Then, based on a hypothetical project and using Lagos, Ibadan, Port Harcourt and Abuja as pilot locations (with Lagos as the base location), LFs were calculated for the four locations. The LFs obtained were validated using tender prices for the primary school projects of the Universal Basic Education Programme financed by the Federal Government of Nigeria.

The results showed that tender price levels were higher in Abuja and Port Harcourt and lower in Ibadan, compared to Lagos (the base location) on the basis of their location differences. Although the results underestimated the actual values of the LFs by only 8%, which is well within the acceptable level of early price estimating accuracy for quantity surveyors, the insufficient and scanty data used limits their statistical reliability. It is hoped that more detailed studies, based on more locations and using more project samples, would be carried in the near future to further the development of LFs for construction price estimating in Nigeria.

Keywords: Price estimating, project management, location adjustment factors, construction industry, Nigeria

Abstrak

Hierdie artikel ondersoek die gebruik van Plek Faktore (PF) as 'n empiriese hulpmiddel vir die oorskakeling van konstruksiepryse vanaf een plek na prys op 'n ander plek. Die oogmerk was om PF's vir geselekteerde plekke te genereer om sodoende 'n belangstelling in die konsep aan te wakker. Eerstens is plekfaktore wat konstruksiepryse beïnvloed deur middel van 'n literatuurstudie geïdentifiseer. Daarna, gebasseer op 'n hipotetiese projek is Lagos, Ibadan, Port Harcourt en Abuja (met Lagos as die basis plek) as loots plekke gebruik om PF's vir die vier

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plekke te bereken. Die verkrygde PF's is waardes toegevoeg deur tenderpryse te gebruik vir skoolprojekte van die *Universal Basic Education Programme* wat deur die federale regering van Nigerië gefinansier is.

Die resultate het gewys dat tenderprysvlakke hoër was in Abuja en Port Harcourt en laer in Ibadan, vergelykend met Lagos (die basis plek) op die basis van hulle plekverskille. Alhoewel die resultate wys dat die ware waardes van die PF's met slegs 8% onderskat is, wat goed is in vergeleke met die aanvaarbare vlak van voorafprysskatingsakkuraatheid vir bourekenaars, het die onvoldoende en geringe data wat gebruik is die statistiese betroubaarheid daarvan verminder. Daar word gehoop, dat meer uitgebreide studies, gebaseer op meer plekke en deur gebruik van meer projekvoorbeelde, in die toekoms uitgevoer sal word vir die ontwikkeling van PF's vir konstruksieprysskatings in Nigerië.

Sleutelwoorde: Prysskattings, projekbestuur, plekaanpassingsfaktore, konstruksie-industrie, Nigerië

1. Introduction

Estimating, according to the Chartered Institute of Building (1997), is the technical process of predicting the cost of construction. It involves the building up of rates for building elements and components based on the cost of labour, material and plant. The sum of the costs of the various elements and components that make up a project is the cost of the project to the contractor. The addition of the contractor's profit and overhead margins as well as the relevant taxes converts a cost estimate into a tender price (Kwakye, 1994). Thus the cost estimate serves not only as a basis upon which a tender figure is derived for the selection of a suitable contractor (Ashworth, 2002) but also as a basis for a project's ultimate funding by the project owner (Trost & Oberlender, 2003). Early price estimating forecasts a contractor's tender sum (Ashworth, 1994).

A good estimator can readily estimate the cost of a project in his area of operation, but it may not always be so for projects outside his area of operation (Russell, 2002). This is because, according to Humphreys (2005), while cost engineers, quantity surveyors, and project managers are generally very familiar with the major sources of cost data in their areas of operation, they are often unaware of useful sources of cost data and related information in other areas. This problem arises because there is usually lack of time to perform a proper search for information about key factors that can impact the estimate for particular geographic locations. A location adjustment factor enables an estimator to adjust the historical price data for construction in a particular location to estimate the price of a similar project in another location (Yoshihara & Tametoh, 2002)

Location has a significant impact on the major components of construction cost and price, namely materials, labour and plant

(Bilginsoy & Philips, 2000; Pearl *et al*., 2003; Wilmot & Cheng, 2003). Thus, according to Seeley (1996), material, labour and plant costs in construction projects are dependent not only on the geographical location of the project but also on the site conditions. Construction projects unlike the products of the manufacturing industry are never the same. Each project, according to Peansupap & Walker (2005), is unique in its location. Hence construction projects are exposed to locational variations in addition to a whole range of design factors. This is why project location has been identified by Ahmad & Minkarah (1988), Shash (1998) and Akintoye (2000) as one of the significant factors influencing contractors' tender price levels.

This article is a preliminary investigation to quantify the effect of locational differences on construction prices for some selected cities in Nigeria using Lagos as the base location. The article was aimed at provoking interest in the concept of locational adjustment factors among cost professionals. Lagos was chosen as the base location because of its strategic position not only as Nigeria's major seaport but also as its commercial capital which has the highest concentration of construction firms and professionals in any single city in the country (Dada, 2005).

2. An overview of locational factors and their influence on construction price

Location affects construction price via institutional and market factors, and through geographical realities. The institutional factors include local regulations (Russel, 2002) and the level of taxation (Seeley, 1996) while demand and supply of construction inputs are some of the market factors. Geographical realities include such things as accessibility and topography (Seeley, 1996, Singh, 2007), local climate (Ferry & Brandon, 1991; Parker & Dell'Isola, 1991; Singh, 2007). According to Avery (1982), some of these factors have a bearing on the cost (and hence the price) of executing work and consequently concern tenderers as well as estimators. Also, in a global study of factors affecting contractors' tender margins, Ling (2005) found that project location had a significant impact in many countries.

Generally, the more remote a project location is, the more expensive it will be because of the cost of transporting construction materials and equipment to the site (Avery, 1982, Parker & Dell'Isola, 1991; Akintoye, 2000). Remote locations, according to Mutunga & Talukhaba (2004), are those characterised by low levels of investments in terms of both communication infrastructure and facilities, as is common in a lot of rural set ups of most of the developing world.

In Britain, for example, Anderson (1988) has observed that there are regions within the British Isles where market conditions are so distorted that any interpretation of standard cost data is fraught with difficulty. Within a country there may exist regions exhibiting what Anderson (1988) described as extreme regionality such that economic and social conditions within the areas, regions, states or localities can be isolated from other areas, regions, states or locality to the extent that extrapolation of cost data can be very inaccurate. Avery (1982) identified remoteness from source of materials and plant supply, labour cost and productivity, water and power supply for the works, climate and weather, regional market conditions or tendering climate and local tendering customs as the locational factors that may have an impact on the cost of executing work to any given design. According to Herbsman & Ellis (1991) and Motwani *et al*. (1995), location is one of the critical factors that affect construction productivity. The effect of location also expresses itself in the fact that restricted urban construction sites always pose considerable difficulties for contractors with regard to logistics and planning. These stem from the inherent problems in offloading materials from confined locations, the lack of storage space within which materials can be stockpiled and local traffic and delivery restrictions to protect the city centre environment within office hours (Ison *et al.*, 2004). As a result of these factors, the cost of construction varies from place to place even for projects of similar design, magnitude and size. This variation could increase the total cost of a project by as much as a third from one location to another (Stallworthy & Kharbanda, 1983). It is not surprising therefore that several authors including Akintoye (2000) and An *et al*. (2007) have ranked location among the significant factors that influence construction price estimates.

3. The need for locational factors in construction price forecasting in Nigeria

Nigeria is a vast country occupying a land area of 923768 square kilometres. It is situated between Longitude 3° and 15° East and Latitude 4° and 14° North (Central Bank of Nigeria, 2000). The longest distance from East to West is about 767 kilometres, and from North to South is about 1605 kilometres. The landscape comprises lowlands, plains, highlands and plateaux. The country also exhibits very wide geographical and climatic variations, comprising the mangrove forests at the coast, evergreen rainforests, deciduous forests, Guinea savannah in the middle belt, Sudan savannah in most parts of the north, and the Sahel, semi-arid desert at the extreme northeast

(Central Bank of Nigeria, 2000). It operates a federal system comprising 36 autonomous states and the Federal Capital Territory (Abuja) as well as 774 local government councils. The country has a market economy.

It can be argued that all the locational factors discussed above are relevant in Nigeria due to its large size and geographical diversity. These factors should therefore be of concern to both professional quantity surveyors and contractors' estimators in the construction industry. Indeed in Nigeria, the prices of construction inputs and hence construction prices vary from state to state and local government area to local government area. This is because the country operates a free market economic system and taxation levels differ between the states (Central Bank of Nigeria, 2000). In a developing country like Nigeria where most development projects, such as the construction of schools, health facilities and housing are sponsored by the government, the use of location adjustment factors should be especially useful. The use of location adjustment factors will make it possible for the government (and its project consultants) to estimate the contract price of a prototype design for different parts of the country without going through the lengthy process of collecting cost data for each location. Contractors could also use it to prepare tender estimates for projects all over the country without necessarily visiting every locality to collect estimating data.

4. Conceptual framework and research methodology

Preliminary price estimating by quantity surveyors predict contractors likely tender sums and enable construction clients to have an idea of their financial commitments early in the project cycle (Ashworth, 1994; Seeley, 1996). The estimates are usually based on historical cost data generated from completed buildings to provide a reasonably accurate prediction of the construction price of a new project (Smith, 1995). These estimates are produced at a specific point in time for a specific location and the prices used therein are (unless other parameters are specifically set) relevant only for that date and location. For this reason, adjustments need to be made to reflect differences in price levels and project characteristics including location (Phaobunjong & Popescu, 2003). Thus estimates based on historical cost data need to be adjusted for inflation or price levels (Chau, 1990; Parker & Dell'Isola, 1991; Singh, 2007), and locational differences (Parker & Dell'Isola, 1991; Elhag & Boussabaine, 1999; Al-Harbi *et al.*, 1994; Singh, 2007), among other factors.

4.1 Adjustment of Estimates Using Tender Price Indices

Price indices are used to update the price of goods and services over time to reflect variations in inflation and price levels (Yu & Ive, 2006). They provide a comparison of price changes from period to period for a fixed quantity of goods or services (Williams, 1994). Beyond tender price inflation, the index should also reflect regional differences, differences in pricing level resulting from size of the contract, site problems (other than those which have design implications) and any other factor which has influenced the price quoted by the accepted tenderer.

According to Yu & Ive (2006), the three common types of price indices are the Laspeyres Price Index, the Paasche Price Index and the Fisher Ideal Index. The Laspeyres price index is a base weight index which uses the relative quantities of the base period to provide the weighting for the respective prices. On the other hand, the Paasche price index is a current weight index. The Laspeyres Price Index has been found to overstate inflation while the Paasche Price Index understates it (Yu & Ive, 2006). The Fisher Price Index takes the average of these indices as a better approximation to the true measure of inflation (Fisher, 1921 cited in Yu & Ive, 2006). Costello & Watkins (2002) and Yu & Ive (2006) give details of the mathematical calculations of the three indices. The BCIS tender price index series which measures the trend of contractors pricing levels in accepted tenders is a commonly used index in the UK construction industry (Yu & Ive, 2006). This index is adjusted for location using the following formula (Elhag & Boussabaine, 1999):

$$C_{adjusted} = C_{actual} * \frac{TPI_{base}}{TPI_{actual}} * \frac{M.L.F.}{C.L.F.} \qquad \text{Equation 1,}$$

Where:
$C_{adjusted}$ = adjusted lowest tender price
C_{actual} = actual lowest tender price
TPI_{base} = average tender price index for the base year
TPI_{actual} = tender price index at tender date of a specific project
M.L.F. = mean location factor of UK for base year
C.L.F. = county location factor of a specific project
The basis of the adjustment for location in Equation 1 above is yet to be modelled (Yu & Ive (2006).

4.2 Adjustment of Estimates for Location

A tender price index is most commonly used to adjust an estimate based on historical data to current price level (Ferry & Brandon, 1991; Yu & Ive, 2006; Singh, 2007). The need to adjust for locational differences has been widely established in literature. A location adjustment factor is an instantaneous, overall, total adjustment factor for converting a base construction estimate from one geographical location to another (Humphreys, 2005). It identifies disparities in construction materials costs, labour hourly rates, productivity, freight rates and taxes, among others, between different project locations (McConville, 1994). However, the cost of land, scope/design differences for local conditions and codes, and differences in operating philosophies are not included in a location factor (Pietlock, 1994). Also, if the designs are not identical for different locations, the cost differences are not generally accounted for by locational factors alone (Humphreys, 2005).

The formula for updating a construction price from a base year (Y_b) to a current year (Y_c) is generally given as (after Phaobunjong & Popescu, 2003).

$$\text{Price for } Y_c = \text{Price for } Y_b \times \frac{\text{Index for } Y_c}{\text{Index for } Y_b} \qquad \text{Equation 2}$$

Based on Equation 1 and Equation 2, the Location Factor (LF) for location A relative to location B is defined for this study as:

$$LF_A = , \frac{\text{Price of construction at location A}}{\text{Price of construction at location B}} \qquad \text{Equation 3}$$

where B is the base location.

This formula assumes that only locational variations as discussed earlier in the literature account for the differences in price between the two locations (with all other factors already taken into consideration).

Adopting the method used by Olukoju (1995), Proverbs *et al*. (1999) and Xiao & Proverbs (2002a; 2002b), this study used an appropriate hypothetical project (a prototype single-storey block of classrooms) as the basis of a price survey. The unprized bill of quantities of the prototype project was sent to practising quantity surveyors in the cities of Lagos, Abuja, Ibadan and Port Harcourt to price simultaneously.

The respondents were also asked to list the factors peculiar to their locations which they took into account in pricing the bill.

Using the average costs returned for the cities, and with Lagos as the base city, the Location Factor (LF) for each city relative to Lagos was calculated using the formula in Equation 3. Thus the LF for location X is given by

$$LF_X = \frac{\text{Price of the hypothetical project at location X}}{\text{Price of the hypothetical project at base location (Lagos)}} \quad \text{Equation 4}$$

The predicted LFs were subjected to an empirical validity test using real case study projects in the same selected locations. This was necessary to measure how closely the LFs calculated with the hypothetical project approximated those calculated with the real case study projects (Law & McComas, 1990). The validation serves to show the authenticity and usefulness of the predicted LFs by measuring the extent to which they accord with those for the real projects. The relative measure of accuracy used was the mean variance ratio (after Wilson, 1994 and Odeyinka & Yusif, 2003) between the predicted and the real LFs. The results are shown in Table 4.

For the validation, the tender prices of the Federal Government of Nigeria Universal Basic Education (UBE) primary school projects were obtained for the selected cities. The projects comprised the construction of blocks of classrooms similar in scope and design to the hypothetical project used in this study. Since the pricing of the bills of quantities for the hypothetical project and the construction of the real case study projects were within the same time period, it was not necessary to adjust the project values for time and inflation.

5. Results and discussion

The estimated tender prices of the hypothetical projects and the real (Universal Basic Education) projects in the four locations are shown in Table 1.

Table 1: Project costs

Location	*Estimated Tender Price of hypothetical project (₦)**	*Tender Price of the real project ((₦)**
Lagos	4 814 520.00	5 019 205.34
Abuja	4 932 310.00	5 019 205.34
Ibadan	4 573 640.00	4.416 900.90
Port Harcourt	6 121 608.00	5 270 165.60

*₦120 is equivalent to US$1

In Table 2, some of the peculiar factors the respondents considered in pricing the bill of quantities for the hypothetical projects in their locations are listed. They include, among others, "High level of multiple taxations by the three tiers of government" in Lagos and "High level of insecurity due to political agitations by youths resulting in a very high level of administrative costs" in Port Harcourt in the volatile Niger Delta Region. These factors reflected mostly the differences in the rate of taxation and cost of construction inputs due to different market situations in the four locations.

Table 2: Locational Factors considered by respondents

Location	*Factors influencing pricing levels*
Lagos	Materials labour and plant readily available compared to other cities. High level of multiple taxation by the Federal state and local governments. High cost of living makes administrative cost very high.
Abuja	High cost of living because it is the seat of government Skilled labour is not readily available
Ibadan	No special features it is just average
Port Harcourt	Construction labour very scarce because of the attraction of the oil industry Prices of goods generally high due to high cost of living High level of insecurity due to political agitations by youths resulting in a very high level of administrative costs (Niger Delta crisis).

Applying the formula in Equation 4 and using the data in Table 1, the predicted and the actual LFs were computed. Table 3 shows the figures obtained.

Table 3: Predicted and Actual Location Adjustment Factors

Location	*Predicted Location Factor (LF_P)*	*Actual Location Factor (LF_A)*
Lagos (base location)	1.000	1.000
Ibadan	0.950	0.880
Abuja	1.025	1.000
Port Harcourt	1.272	1.050

To validate the results obtained, the two sets of LFs were subjected to variance analysis to measure the accuracy and usefulness of the predicted LFs. The mean variance ratio ($\overline{V}$) is expressed by Wilson (1994) as:

$$\overline{V} = \sum_{i=1}^{n} \frac{Vi}{n}, \qquad \text{Equation 5}$$

where $V_i = (LF_A)_i \;/\; (LF_P)_i$

V = Variance ratio
LF_A = Actual location factor
LF_P = Predicted location factor
n = number of observations

The results of the variance analysis are shown in Table 4.

Table 4: Variance analysis of Actual and Predicted Location Factors (LFs)*

Location	*Actual Location factor (LF_A)*	*Predicted Location Factor (LF_P)*	*V_i = LF_A/LF_P*	*Accuracy level (%)*
Ibadan	0.880	0.950	0.93	7
Abuja	1.000	1.025	0.98	2
Port Harcourt	1.050	1.272	0.83	17

$\overline{V}$ = 0.92 *$LF_A = LF_P = 1$ for Lagos (the base location)

According to Wilson (1994), ideally $\overline{V}$= 1 when the predictions are 100% accurate. As shown in Table 4, the mean variance ratio is 0.92. This means that, on the average, the actual location factors were underestimated by 8%. This degree of accuracy is within the accuracy range of -5% to +10% for early price estimates (Oberlender, 1993; Harbuck, 2002) and is quite acceptable for an exploratory study of this nature. However, due to the fact that only one project and a few locations were used in this study, the statistical validity of the results may be in doubt.

6. Conclusion and recommendation

This article has examined the concept of location adjustment factors in construction price estimating and demonstrated a very simple and straightforward approach to developing them. The results showed that, compared to Lagos, location factors (and hence tender price levels) were higher in Abuja and Port Harcourt and lower in Ibadan. However, the results obtained in this article are fraught with limitations due to the insufficient and scanty data used. The results are based on only 4 cities and only a sample project was used in generating the factors. This casts some doubts on the statistical reliability of the results as the study violates the requirement for a large volume of data for constructing good and reliable location factors (Stallworthy & Kharbanda, 1983).

It is our belief that in spite of the limitations acknowledged above, the results should explain to some degree the regional differences in the construction prices published by the Nigerian Institute of Quantity Surveyors and other organisations in Nigeria. It is hoped that the study may attract the attention of major stakeholders in the Nigerian construction industry and engender interest in locational factors among academics and practitioners in the field of construction price estimating. It is therefore recommended that more detailed studies should be undertaken to generate more accurate and reliable locational factors. Further studies should model locational factors on such location attributes as ratio of construction inputs obtained in a location, labour productivity rates, taxation levels and freight rates, *etc*. as suggested by Yoshihara & Tametoh (2002).

References

Ahmad, I. & Minkarah, I. 1988. Questionnaire Survey on Bidding in Construction. *Journal of Management in Engineering*, 4(3), pp. 229-243.

Akintoye, A. 2000. Analysis of factors influencing project cost estimating practice. *Construction Management and Economics*, 18(1), pp. 77-89.

Al-Harbi, K.M., Johnston, D.W. & Fayadh, H. 1994. Building construction detailed estimating practices in Saudi Arabia. *Journal of Construction Engineering and Management,* 120(4), pp. 774-784.

An, S., Kim, G. & Kang, K. 2007. A case-based reasoning cost estimating model using experience by analytic hierarchy process. *Building and Environment*, 42(7), pp. 2573–2579.

Anderson, L. 1988. Going to Extremes. *Chartered Quantity Surveyor*, 10(11), p.15.

Ashworth, A. 1994. *Cost studies of buildings*. London, UK: Longman Scientific and Technical.

Ashworth, A. 2002. *Pre-contract studies: development economics, tendering and estimating*. 2nd edition, Oxford, UK: Blackwell Scientific.

Avery, D.W. 1982. Problems of locality in construction cost forecasting and control. In: Brandon, P.S. (ed.), *Building Cost Techniques: New Directions*. E. & F.N. Spon, London, pp.159-168.

Bilginsoy, C. & Philips, P. 2000. Prevailing wage regulations and school construction costs: evidence from British Columbia. *The Journal of Education Finance,* 25(1), pp. 415-432.

Central Bank of Nigeria. 2000. *The changing structure of the Nigerian economy and implications for development*. Lagos, Nigeria: Realm Publications Ltd.

Chartered Institute of Building.1997. *Code of Estimating Practice*. 6th Edition, Longman, London: The Chartered Institute of Building.

Chau, K.W. 1990. On the estimation of the price trend and output growth rate of the Hong Kong construction industry. *Journal of Real Estate and Construction*, 8(1), pp. 46–59.

Costello, G. & Watkins, C. 2002. Towards a system of local house price indices. *Housing Studies*, 17(6), pp. 857-873.

Dada, J.O. 2005. An assessment of risk factors in the procurement of building projects in Lagos and Abuja. Unpublished MSc. thesis, Department of Quantity Surveying, Obafemi Awiolowo University, Ile-Ife, Nigeria.

Elhag, T.M.S. & Boussabaine, A.H. 1999. Tender price estimation: neural networks vs. regression analysis. In: Proceedings of the RICS (COBRA) conference, pp. 114-123.

Ferry, D.J. & Brandon, P.S. 1991. *Cost planning of buildings*. London: BSP Professional books.

Harbuck, R.H. 2002. Using models in parametric estimating for transportation projects. *AACE International Transactions*, pp. EST.05.1-EST.05.11.

Herbsman, Z. & Ellis, R. 1991. Research of factors influencing construction Productivity, *Construction Management and Economics*, 8(1), pp. 49-61.

Humphreys, K.K. 2005. Sources of international cost data. Updated keynote address presented at the NORDNET '97 Conference "Quality in Project Management", Reykjavik, Iceland, 11 September 1997. Available from: <http://www.icoste.org/intldata.htm> [Accessed 19 September 2006]

Ison, S., Dainty, A. & Wall, S. 2004. The Construction sector, congestion charging and exemptions. *Engineering, Construction and Architectural Management,* 11(6), pp. 386-394.

Kwakye, A.A. 1994. *Understanding tendering and estimating*, London: Gower.

Law, A.M. & McComas, M.G. 1990. Secret of successful simulation studies. *Industrial Engineer*, 22(5), pp. 47-72.

Ling, F.Y.Y 2005. Global factors affecting margin-size of construction projects. *Journal of Construction Research,* 6(1), pp. 91-106.

McConville, J.G. 1994. Cost estimating of overseas construction projects. *AACE International Transactions*. pp. INT.4.1-INT.4.6.

Motwani, J., Kumar, A. & Novakoski, M. 1995. Measuring construction productivity: a practical approach. *Work Study*, 44(8), pp. 18-20.

Mutunga, T.M. & Talukhaba, A.A. 2004. Effective communication for remote projects. Proceedings of the 2nd Postgraduate conference, Cape Town, South Africa, 10-12 October, pp. 189-199.

Oberlender, G.D. 1993. *Project management for engineering and construction*, New York: McGraw-Hill Inc.

Odeyinka, H.A. & Yusif, A. 2003. An Assessment of the accuracy of quantity surveyors' preliminary cost estimates in Nigeria. *Revista Ingeniera de Construccion (Journal of Construction Management)*, 18(1), pp.33-38.

Olukoju, O.B. 1995. The effect of site location and site conditions on construction cost. Unpublished B.Sc. Dissertation, Department of Quantity Surveying, Obafemi Awolowo University, Ile-Ife, Nigeria

Parker, D.E. & Dell'Isola. 1991. *Project budgeting for buildings*. London: Chapman and Hall.

Peansupap, V. & Walker, D. 2005. Factors affecting ICT diffusion: a case study of three large Australian construction contractors. *Engineering, Construction and Architectural Management,* 12(1), pp. 21-37.

Pearl, R.G., Akintoye, A., Bowen, P.A. & Hardcastle, C. 2003. Analysis of tender sum forecasting by quantity surveyors and contractors in South Africa. *Acta Structilia (Journal for the Physical and Development Sciences*), 10(1), pp. 5-34.

Phaobunjong, K. & Popescu, C.M. 2003. Parametric cost Estimating model for buildings. *AACE International Transactions,* pp. EST.13.1-13.14.

Pietlock, B.A. 1994. Developing location factors using a factoring method. Available from: <http://www.icoste.org/korev94.htm> [Accessed 27 September, 2006].

Proverbs, D.G., Holt, G.D. & Olomolaiye, P.O. 1999. Factors impacting construction project duration: a comparison between France, Germany and the U.K., *Building & Environment*, 34(2), pp. 197-204.

Russel, R.L. 2002. Estimating using international factors. *AACE International Transactions*, pp. INT.03.1-INT.03.3.

Seeley, I.H. 1996. *Building economics*. 4th Edition. London: Macmillan Press Ltd.

Shash, A.A. 1998. Bidding practices of subcontractors in Colorado. *Journal of Construction Engineering and Management*, 123(3), pp. 219-225.

Singh, A. 2007. Approximate estimating methods for typical buildings. *Cost Engineering*, 49(8), pp. 28-31.

Smith, A.J. 1995. *Estimating, tendering and bidding for construction: theory and practice*. London: Macmillan.

Stallworthy, E.A. & Kharbanda, O.P. 1983. *Total project management: from concept to completion*. Aldershot, Hants: Gower.

Trost, S.M. & Oberlender, G.D. 2003. Predicting accuracy of early cost estimates using factor analysis and multivariate regression. *Journal of Construction Engineering & Management*, 129(2), pp. 198-204.

Williams, T.P. 1994. Predicting changes in construction cost indexes using neural networks. *Journal of Construction Engineering and Management,* 120(2), pp. 306-320.

Wilmot, C.G. & Cheng, G. 2003. Estimating future highway construction costs. *Journal of Construction Engineering and Management*, 129(3), pp. 272-279.

Wilson, S.J. 1994. Using statistical process control to improve the accuracy of cost estimates. *The Cost Engineer*, 32(3), pp. 6-9.

Xiao, H & Proverbs, D. 2002a. The performance of contractors in Japan, the UK and the USA: an evaluation of construction quality. *International Journal of Quality & Reliability Management,* 19(6), pp. 672-687.

Xiao, H & Proverbs, D. 2002b. Construction time performance: an Evaluation of contractors from Japan, the UK and the US. *Engineering, Construction and Architectural Management,* 9(2), pp. 81–89.

Yoshihara, K. & Tametoh, S. 2002. Location factors for Southeast Asia. *AACE International Transactions*, pp. INT.04.1-INT.04.8.

Yu, M.K.W. & Ive, G. 2006. A survey of building price indices compiling methods in Britain. Proceedings of the RICS (COBRA) conference, University College London, 7-8 September pp. 784-800.