AN INTEGRATED APPROACH TO MARK-UP DETERMINATION FOR LARGE BUILDING CONTRACTORS IN GHANA

E. Badu and P. Amoah
Department of Building Technology,
Kwame Nkrumah University of Science and Technology

ABSTRACT

Most clients in Ghana use the competitive bidding system to select a suitable contractor to execute a building project. The bid price, submitted by contractors, comprises an estimate of the direct cost, indirect cost and a mark-up. The mark-up is a percentage of the estimated total cost, which a contractor adds to the estimated direct and indirect costs to account for head office overhead costs, profit and contingencies. The size of the mark-up for a contractor varies from one bid to another, depending on a multiplicity of internal and external factors that are encountered in each mark-up decision. The very existence of a construction firm depends on its ability to assign an appropriate mark-up, which will enable the company to get enough jobs and significant profits. Therefore, it is a must that each contractor develops an integrated approach for determining this mark-up, which allows the company to achieve its objectives under different bidding situations. This paper first identifies the most important factors affecting the determination of the mark-up and further highlights the use of the selected factors to establish a fair and reasonable mark-up that satisfies the required rate of return of the contractor from the particular (or at least the general risk-class of) project at hand. The approach developed will provide an analytical tool for establishing optimum mark-up for construction projects in Ghana.

Key words: *Mark-up, Bidding, Pricing practices,Ghana*

INTRODUCTION

A construction firm may secure the right to provide services in a job through either a direct negotiation with the client or the client's representative, or competitive bidding. This study is concerned with the competitive bidding situation in Ghana. Most clients in Ghana use the competitive bidding system to select a contractor to execute a building project. In most cases the client's agency advertises in trade and local newspapers its intention of selecting a lowest responsive bidder for constructing a project that is described in drawings and specifications. A contractor who is qualified to bid studies the bidding documents and decides either to bid or not to bid. A contractor who is interested in performing the job will independently prepare a bid price and submit it in a sealed envelope to the client or the client's representative prior to a designated time of bid opening. During bid opening, envelopes are opened, bids are announced and the apparent lowest bidder is declared. The evaluation process is performed and the job, usually, is awarded to the lowest evaluated bidder. A submitted bid is an offer. When the client accepts the bid, it is binding. The bid price comprises an estimate of the direct cost, indirect cost and a mark-up. The estimated direct cost is the sum of labour, material and equipment costs that are assumed to occur in the execution of the project drawings and specifications. The indirect cost is the sum of all costs which are traceable to the project but which are not traceable to a single activity. This account is designated as job overhead.

The mark-up is a percentage of the estimated total cost which a contractor adds to the estimated direct and indirect costs to account for head office overhead cost, profit and contingencies (Clough, 1975). The size of the mark-up for a contractor varies from one bid to another, depending on

multiplicity of internal and external factors that are encountered in each mark-up decision. The very existence of a construction firm depends on its ability to assign an appropriate mark-up (Morse, 1977), which produces enough jobs and significant profits. Therefore, it is a must that each contractor develops a strategy for determining this mark-up, which allows the company to achieve its objectives under different bidding situations.

The mark-up should ideally consider;

- A "risk-free" return on the contractor's investment in the project commensurate with the return available on other risk-free investment opportunities.
- A "premium" to compensate the contractor for the uncertainties involved in the project ("Contingencies" are often considered to include this compensation).
- The risk-return preferences of the firm's equity holders, and not that of the management.
- The competitive environment in which the contract is awarded.
- A "reasonable" compensation for the human resources and skills to be utilized in the project, such as business, financial and managerial expertise, professional experience and technical know-how.
- Other difficult, if not impossible, to quantify factors such as potential improved competitive position and opportunity to acquire new and valuable experience.
- An allowance for the recovery of an "appropriate share" of the head office overhead expenses if contractually excluded from being directly charged to the client.
- An adequate allowance for the marginal tax expenditures that the contractor may incur under the various sales and income tax laws applicable to the project or the firm.

The determination of the right amount of mark-up is an essential task of all contractors. However, how to determine this amount is not an easy task.

Pricing Practices

Pricing in the construction industry is a "crude art" based on professional expertise, experience and subjective judgement of the estimator or the quantity surveyor. The reason is the uniqueness of the nature of product from the construction industry. The goals of most pricing decision models is to achieve a broader objective of enterprise with regards to the goals of the firm-maximisation of profits, maximisation of sales, achieving a "satisfactory" level of profits, achieving a target market share, maximisation of managerial perks and salaries, etc.

A high profit project, in real life, is normally characterized by a high degree of risk and therefore the need arises to weigh return against risk and select projects, which maximises the value of the shareholder's wealth. The various price setting models used in the Free-market economies are classified as Cost-oriented pricing where costs set the floor for the price a company charges for its products; Demand oriented pricing, where a customer's perception of value, not the firm's cost structure is considered when setting pricing and then Competition-oriented pricing where prices are set on the basis of the prices competitors charge for similar products.

The methods of awarding construction contracts can be classified in two ways: Negotiated contracts and Competitive - Bid contracts. There are short falls associated with this however. Dun and Bradstreet attribute it to the lack of financial and managerial skills. In Ghana, a good number of contractors have long assumed that any cedi beyond the "estimated total cost" of a project is a cedi of profit. The definition of estimated total cost however is far from universal. There are indications that in some cases the estimated total cost has been perceived as actual cost of the project overlooking the uncertainty inherent in the expectation of a future event.

Target Pricing, a new approach for construction contracts, attempts to ensure an adequate return on the investment of the firm. It reconciles cost-oriented and competition-oriented pricing models.

Previous Studies

36 potential factors affecting a contractor's decision on mark-up size for a project were identified. These factors are classified into five (5) categories. These are the project characteristics, project documents, company characteristics, bidding situation and the economic situation.

Four studies involved with the development of a more systematic method of computing mark-up

were reviewed. These are Wages of Risk by J.M. Deponai (1980), Construction Contract Mark-up related to Forecasted Cash Flow by Fondahl and Bacarreza (1972), Construction Project Mark-up Decision under Conditions of Uncertainty by Bacarreza (1973) and Fair and Reasonable Mark-up (FaRM) Pricing Model by F. Farid (1981). The Fair and Reasonable Mark-up (FaRM) Pricing Model, which uses the present value approach, seemed amongst the models the most suitable to solving the problem at hand. The study therefore seeks evidence to support or challenge the propositions of the Fair and Reasonable Mark-Up (FaRM) Pricing Model.

Review of Systematic Methods of Mark-up Computation

The first, which is the Wages of Risk method, is an interpretation of weighted Guidelines method, which had the objective of determining profit objectives on Corps of Engineers contracts. Five factors (Relative difficulty of work, contractor participation, type of contract, duration of work, and fixed asset investment) are assigned the "appropriate weight' from zero to one based on circumstances of the contract at hand. The weights are multiplied by the "predetermined rates" in order to determine a value for the contribution of each factor to the profit objective. The summation of the values obtained prescribes the "Profit Objective" in terms of mark-up percentage.

The main shortcoming of the method is the implied assumption of a 12% ceiling for mark-up. The second and third research projects, which are closely related to each other, resulted in the Cash Flow–mark-up model proposed by Fondhal and Bacarreza. It applies the principles of capital budgeting by reason of consideration of construction projects as a capital investment. The shortfall associated with this is the lack of consistency with respect to precision exercised in different parts. There are difficulties in the interpretation of results and there is also a lack of meaningful data to be employed in the model.

Farid's "Fair and Reasonable Mark-up (FaRM) Pricing model" follows a Net Present Value approach employing an expected value cash flow schedule. This model considers the uncertainties inherent in the determination of the required rate of return and is also based on reasonable, adequate and easily accessible information, quantitative in nature and yields a Minimum Acceptable Price. It also considers the interrelations of the factors of Mark-up and incorporates them into the model through the Required rate of Return and Cash flow schedule of the Project.

Risk Incorporation into Mark-up computation

Risk in construction projects is significantly reduced by prudent application of risk analysis techniques.

Traditionally contractors subjectively include an allowance for the perceived risk of the project in their final bid prices. These are contingency sums included in the mark up which is intended to cover both profit and contingency.

Formal risk analysis methods include Dual Risk Return (DRR), Certainty Equivalent (CE) and Risk-Adjusted Discount rate methods. These are mainly formulae representations of management's perception, the application of risk free rates to calculations and allowance for the time value of money and for uncertainties involved in the cash flow stream of the project.

Research Methodology and Data Collection

In order to provide a tool to assist Ghanaian building contractors to establish optimum mark-up for construction projects, a research in the form of literature review and a survey using questionnaire approach was undertaken. An integrative review, which aims at summarizing past research by drawing overall conclusions from separate studies that are believed to address related or identical hypothesis was used. The guiding question was "What is the optimum mark-up for each project that establishes the minimum acceptable price for the project below which the contractor should not accept the project, and to relate this to the lowest bid selection criterion currently in use in the construction industry. How does the implementation of this system influence contract pricing decisions?" Attention was given to both internal and external factors affecting this.

The research was carried out in three phases. Firstly, a literature search was undertaken from industry and academic journals. Secondly, a modified closed- ended questionnaire from studies

at University of Cincinnati by Ahmed and Minkharah (1988) was posted to a sample of Ghanaian building contractors. The results of the questionnaire were then analyzed statistically and used as basis for formulation of a suitable model for mark-up decision. The study was limited to top-level management of classes D1 and D2 building contractors in all 10 regions of Ghana.

Choice of sample was based on a random selection from the 1998 classified building contractors' list prepared by the Ministry of Works and Housing. Sample size was determined using Kish's formula (1965).

$$n = n^1/(1 + n^1/N)$$

where n = sample size

$n^1 = S^2/V^2$

N = total population

V = the standard error of sampling distribution = 0.05

S = the maximum standard deviation of the population elements (Total error = 0.1 at a confidence level of 95%)

$S^2 = P(1-P) = 0.5\ (1-0.5) = 0.25$

P = the proportion of population elements that belong to the defined class

Considering only class D1 contractors, N=96 and a sample size of 49 is calculated. However, for both classes D1 and D2, N = 542 and a new sample size of 84 is chosen. A response rate of 30% was assumed and a total of 200 questionnaires were sent to various classes D1 and D2 construction firms in Ghana. The response rate from the class D1 was 54% and that of class D2 contractors, 33%.

The first part of the questionnaire developed by Ahmed and Minkharah (1988) require information on firm's policy regarding bidding decision-making. The second part of the questionnaire contains questions about the importance level of 36 potential factors affecting the decision on the size of mark-up to be assigned. The respondents were required to check a number on a scale of 1(low level of effect) to 7 (high effect) that reflects their assessment regarding the different factors.

SURVEY RESULTS AND DISCUSSION

A total of 200 questionnaires were sent out to various classes D1 and D2 construction firms in Ghana. Of these, 86 were completed and returned, giving a 43 % overall response rate. Five of the respondents failed to complete the questionnaires fully. These were rejected and not considered for analysis. The discussion assesses the current issues of evaluating the optimum mark-up and relates any implications of the findings to the adoption of a suitable Mark-up model for the Ghanaian building industry. Decision makers with regards to mark up are shown in the Table 1.

The survey shows that only 11.5% of the responding class D1 contractors and 11.8% of the class D2 contractors depend solely on private consultants to decide on mark-ups. This shows that some management of the construction firms is involved in the mark-up decision.

A level of adjudication process before tenders are finalized is suggested by an appreciable number of both D1 and D2 contractors allowing management and in-house estimating departments to decide on mark-ups. It is realized, much with worry, that certain private consultants are not only engaged in the preparation of bid estimates but also in the decision of mark-ups.

These private consultants might not have in-depth knowledge of the firm's characteristics and may also not have the ample time required to prepare a complete, detailed and thorough analysis for a particular bidding situation. Response to the question on recovery of Head office overheads revealed that about 61.6% of firms include head office overhead in mark-up, 16.3% charge it as a cost item and 22.1% do either depending on the project.

The survey also showed that mathematical or statistical models for determining mark-up are rarely used in the Ghanaian building industry. Of the 34 class D2 contractors that responded, 70.6% use pure subjective judgement and 29.4% use estimating to determine mark-up. The numbers are 46.1% and 48.1% respectively for class D1 contractors.

A contractor, who decides to bid on a project, needs to prepare a cost estimate for the project. The survey revealed that the contractors do not depend on cost and value curves for the projects undertaken for cash flow forecasting. The contractor's estimators have very limited time and the drawings are normally inadequate at the tender stage to enable a detailed estimate to be prepared. Less than 4% of the respondents companies use standard S-curves in forecasting cash flow.

Table 1. Contractor classification and Mark-up decisions

Decision Makers	Class D1		Class D2		Overall Percentage responses
	No of responses	Percentage responses	No of responses	Percentage responses	
Management only	7	13.5	4	11.8	12.8
In-house estimating department only	4	7.7	1	2.9	5.8
Private consultants only	6	11.5	4	11.8	11.6
Management + In-house estimating department	27	51.9	13	38.2	46.5
Management + private consultants	6	11.5	11	32.4	19.8
Others	2	3.9	1	2.9	3.5
Total	52	100	34	100	100

Enough evidence was obtained from the analysis to confirm that classes D1 and D2 contractors appreciate the effect of time on the value of money. Less than 5% of the responding firms do not consider the time value of money.

The factors that were thought to affect Project mark-up determination were ranked in accordance to their importance to classes D1 and D2 building contractors in Ghana. The relative importance indices for the various factors were measured using the formula;

$$RII = \Sigma W/(S \times N)$$

where RII = Relative Importance Index
ΣW = the summation of the weighting given to each factor,
S = maximum score = 7
N = Total number of firms that responded in the sample

The factors and the relative importance indices obtained for classes D1 and D2 contractors are given above in Table 2.

The results indicates that when deciding on the mark-up for a project a class D1 contractor looks into the Project characteristics as of most importance and the bidding situation as the least.

The class D2 contractor looks into Project documents as the most important and the project characteristics as the least important. Table 3 illustrates this.

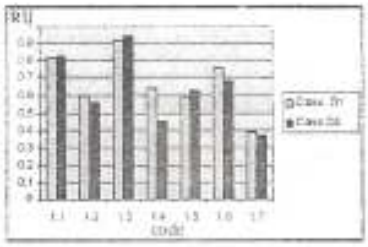
It is evident that project characteristics is the most important category and bidding situation is the least important category for classes D1 contractors when they decide on mark-ups.

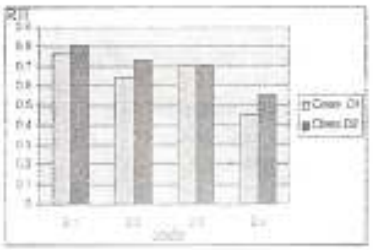
The three top ranked factors by both class D1 and D2 contractors are **Project cash flow, risk involved in investment and Competition** (See Table 2). These three factors were among the nine selected factors that had almost the same importance indices and very close rank orders across the two groups. These three factors are considered to be the most important when considering Mark-up determination. It corroborates well with Farid, F [1981] findings that fair and reasonable mark-up that results in a minimum acceptable price is a function of the required rate of return and the cash flow schedule of the project. The project cash flow is the highest ranked factor in the Mark up decision. This reflects contractor's need for cash. In the Ghanaian Construction industry the major client (the Government) delays in honouring payment certificates and along with difficulty in getting assistance from banking institutions underscores the importance of cash flows to contractors in making decisions on markup.

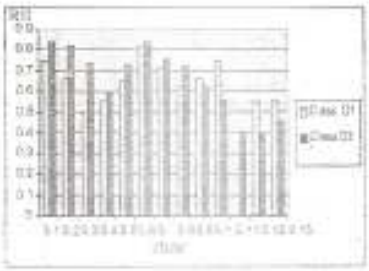
Table 2. Relative Importance Indices and Ranks

Source: Authors' Field Work, 2001

Code	Factor	Class D1		Class D2	
		RII	Rank	RII	Rank
1.1	Size of contract	0.819	6	0.824	6
1.2	Duration	0.602	20	0.559	28
1.3	Project Cash flow	0.918	1	0.937	1
1.4	Type of equipment Required	0.648	17	0.454	32
1.5	Location of project	0.585	21	0.63	18
1.6	Owner/client	0.764	8	0.685	16
1.7	Job Start time	0.387	35	0.37	36
2.1	Type of contract	0.769	7	0.807	8
2.2	Design quality	0.646	18	0.735	12
2.3	Client's Special Requirements	0.701	12	0.706	15
2.4	Designers	0.453	32	0.55	30
3.1	Availability if Required cash	0.75	9	0.836	5
3.2	Uncertainty in cost estimate	0.662	16	0.824	6
3.3	Confidence in work force	0.5	29	0.739	11
3.4	Strength in industry	0.555	24	0.597	25
3.5	Availability of qualified staff	0.651	16	0.727	13
3.6	Need for work	0.824	5	0.84	4
3.7	Experience in such projects	0.714	11	0.761	10
3.8	Established in Long Relationships with Clients	0.624	19	0.718	14
3.9	Past profit in similar jobs	0.662	14	0.626	21
3.10	Current work load	0.747	10	0.559	28
3.11	Reliability of Subcontractors	0.549	25	0.408	34
3.12	Portion subcontracted to others	0.56	23	0.399	35
3.13	Public exposure	0.481	31	0.454	32
4.1	Required Bond capacity	0.522	28	0.605	24
4.2	Competition	0.843	3	0.878	2
4.3	Time allowed for submitting Bids	0.536	26	0.626	21
4.4	Time of bidding (Season)	0.418	34	0.58	27
4.5	Bidding Document Price	0.387	35	0.546	31
4.6	Prequalification Requirements	0.486	30	0.588	26
5.1	Risk involved in investment	0.852	2	0.857	3
5.2	Availability of Equipment	0.687	13	0.655	17
5.3	Overall Economy (Availability of work)	0.832	4	0.777	9
5.4	Quality of available labour	0.533	27	0.609	23
5.5	Availability of labour	0.571	22	0.63	18
5.6	Governmental division Requirements	0.442	33	0.63	18







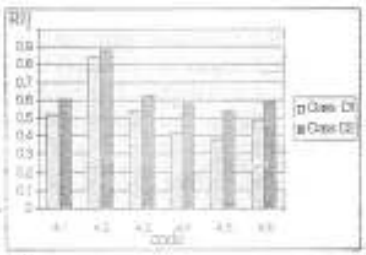


Table 3. Rank order of broad category

Category	Rank	
	Class D1	Class D2
Project characteristics	1st	5th
Project Documents	3rd	1st
Company characteristics	4th	3rd
Bidding Situation	5th	4th
Economic situation	2nd	2nd

The rank correlation between classes D1 and D2 contractors was measured using the Spearman rank correlation coefficient R. The formula is

$$R = 1 - \{6\Sigma d_i^2/[n(n^2 - 1)]\}$$

$$-1.0 \leq R \leq 1.0$$

where n = total number of paired ranks,
x_i = rank of factor i by class D1 contractors
y_i = rank of factor i by class D2 contractors,
d_i = difference between the ranks

A correlation coefficient of 0.76 measured indicates a monotonically increasing relationship between the rankings of factors affecting mark-up by these two classes of contractors.

A Typical Quantification of Mark-Up

Using the FaRM Pricing Model every quantification of the mark-up has to be varied to suit the project particulars, but the following illustration will give some guidance

Project: PROPOSED GUEST HOUSE FOR BT DEPT, KNUST, KUMASI

1. Contractual Requirements

Contract duration = 6 months
Interim valuation = monthly
Retention = 10%
Period for honouring certificates = 3 months.

2. Other Considerations by Contractor

Bank's lending rate (as at June, 1999) = 37% p.a
Required Rate of Return (RRR) = 42% p.a (or 3.5% per month)

Table 4. Project Estimates

Total Estimated cost of Project = ¢375, 000, 000.00

Activity	Percentage of Total cost	Cost ¢'000, 000
1. Mobilisation/ Site preparation	0.8	3
2. Foundations	2.2	8
3. Site works	1.8	7
4. Metal works	6.8	26
5. Concrete	14.6	55
6. Mechanical systems	9.2	34
7. Blockwork	16.7	63
8. Electrical systems	7.5	28
9. Doors/ window	5.3	20
10. Air conditioning	7.2	27
11. Roofing	5.4	20
12. Finishing	5.7	21
13. Flooring	4.3	16
14. Wall covering	2.2	8
Total Direct cost	89.7	336
Project overheads	6.1	23
Head office overheads	4.2	16
TOTAL COST OF PROJECT	100.0	375

Source: Authors' Field Work, 2001

A Gantt chart is prepared based on Table 4 (see Table 5)

Table 5. Modified Gantt chart for BT Guest House

S.N	Activity (Item)	End of Month						Percentage of Total Cost
		1	2	3	4	5	6	
1	Mobilisation/ site Preparation	50	100					0.8
2	Foundations	35	100					2.2
3	Site works	25	50	75	100			1.8
4	Metal works		50	100				6.8
5	Concrete		25	75	100			14.6
6	Mechanical systems		30	60	100			9.2
7	Block work		25	60	95	100		16.7
8	Electrical system		10	20	65	90	100	7.5
9	Doors and windows			30	80	90	100	5.3
10	Air conditioning			10	65	100		7.2
11	Roofing				100			5.4
12	Finishing				50	100		5.7
13	Flooring					100		4.3
14	Wall covering					55	100	2.2
	Project overheads	15	30	50	70	85	100	89.7
	Head office overheads	20	35	50	65	80	100	6.1
Total Cost of Project								4.2
								100.0

Source: Authors' Field Work 2001

It is to be noted that:

- The cumulative percentages of cost of each activity to be completed by the end of periods are shown in the corresponding cells.
- The cost of each activity as a percentage of the total estimated cost of the project is shown in the last column.
- Project overheads are those expenditures necessary for the ultimate completion of the project but not directly assignable to any particular activity.
- Project overheads and head office overheads are included in the table because the concern is the total cost of the project to the contractor.

A cost oriented form of Table 5 is then prepared as Table 6 and Fig 1 (an S-curve).

Translating Incurred Costs into Cash Outflows

Table 7 illustrates a modified form of "cumulative-cash-flow schedule" for the project and depicts the amount and timing of the actual funds transferred taking the period for honouring certificates into consideration (payments time - lag).

Table 6. Modified Cumulative Estimated – Cost Schedule for BT Guest House

S.N	Activity (Item)	End of Month						% of Total Cost
		1	2	3	4	5	6	
1	bilisation/ site Preparation	0.4	0.8					0.8
2	Foundations	0.8	2.2					2.2
3	Site works	0.4	0.9	1.3	1.8			1.8
4	Metal works		3.4	6.8				6.8
5	Concrete		3.6	10.9	14.6			14.6
6	Mechanical systems		2.8	5.5	9.2			9.2
7	Block work		4.2	10	15.9	16.7		16.7
8	Electrical system		0.7	1.5	4.9	6.7	7.5	7.5
9	Doors and windows			1.6	4.2	4.8	5.3	5.3
10	Air conditioning			0.7	4.7	7.2		7.2
11	Roofing				5.4			5.4
12	Finishing				2.8	5.7		5.7
13	Flooring					4.3		4.3
14	Wall covering					1.2	2.2	2.2
	PRIME COST (i.e. total cost of activities)	1.6	18.6	41.3	73.3	87.4	89.7	89.7
	Project overheads	0.9	1.8	3	4.3	5.2	6.1	6.1
	Head office overheads	0.8	1.5	2.1	2.7	3.4	4.2	4.2
	Total Cost of Project	3.3	21.9	46.4	80.3	96.0	100	100.0

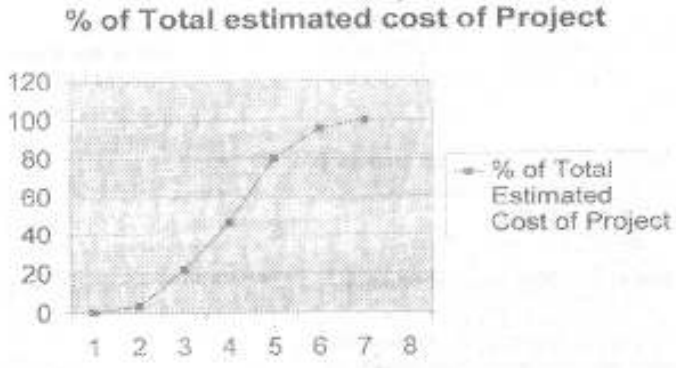


Fig. 1: A Modified-Cumulative - Total - Estimated Cost curve (S-Curve) for BT Guest House

Table 7. Modified – Cumulative-Cash Flow Schedule

Item	End of Month*										% of Total Cost
	0	1	2	3	4	5	6	7	8	9	
(a) Cumulative total cost*	3.3	21.9	46.4	80.3	96.0	100.00					100.00
(b) Bill Policy factor**	1.0	1.0	1.0	1.0	1.0	1.0					1.0
(c) Cumulative billable cost (c=a.b)	3.3	21.9	46.4	80.3	96.0	100.0					100.0
(d) Less Retention@ 10%	(0.33)	(2.19)	(4.64)	(8.03)	(9.60)	(10.0)					(10.0)
(e) Cumulative "payments before markup" due	2.97	19.71	41.76	72.27	86.40	90.0					90.0
(f) Cumulative "Payments before markup" received	-	-	-	-	2.97	19.71	41.76	72.27	86.40	100.0+	100.00

* *Assuming that management requires the company to have sufficient funds available at the end of each period for the total expenditures of the following period.*

** *This factor accounts for the costs that are not immediately reimbursable, and other cases such as "front-end loading", etc*

\- *Total retention is released with the final payment.*

Cash outflows and cash inflows cannot be combined into net cash flows because the cash inflows should be marked-up by the FaRM, which is unknown at this point. For this reason cash inflows and outflows are treated separately in Table 8 where the FaRM is related to the RRR and cash flow schedule of the project.

Marking up the cash inflows by the FaRM (m_f) and setting the Net Present Value (NPV) of the project equal to zero the optimum markup is calculated.

With the receipt of the final payment, the contractor will realize a 15.7% markup, which would just satisfy its 3.5% per month RRR.

Determination of the Minimum Acceptable Price

Once the optimum markup is known the contractor's minimum Acceptable Price (MAP) for the project can be determined.

Total Cost of Project	¢375,000,000.00
Optimum markup @ 15.7%	58,875,000.00
Contract price before bond premium	¢ 433,875,000.00
Bond	869,500.00
Minimum Acceptable Price (MAP)	¢ 434,744,500.00

¢434,744,500 is the Contractor's Minimum Acceptable Price (MAP). The firm cannot accept the project at a price below this MAP without damaging its financial position.

Head office overheads included in mark-up

Considering a situation where head office overheads is not charged as a cost item but included in the mark-up Tables 9 and 10 are used to calculate the optimum mark-up.

Table 8. Determination of Optimum Markup

End of month j	PV Factor @ 3.5% P/F, 3.5%, j	Cash outflows (Total cost for the following month) as % of total cost of project, All negative		Cash inflows (Payments before markup received) as % of total cost of project	
			PV[C_j]	$S_j = h_j - h_{j-1}$	PV[S_j]
(1)	(2)	(3)	(4)	(5)	(6)
0	1.000	3.30	3.30	-	-
1	0.966	18.60	17.97	-	-
2	0.934	24.50	22.88	-	-
3	0.902	33.90	30.58	-	-
4	0.871	15.70	13.67	2.97	2.59
5	0.842	4.00	3.37	16.74	14.10
6	0.814	-	-	22.05	17.95
7	0.786	-	-	30.51	23.98
8	0.759	-	-	14.13	10.72
9	0.734	-	-	13.60	9.98
		ΣC_j	- 100.0	- 91. 77	
		ΣS_j		100. 0	79.32

NPV (3.5%, 9 mo) $= (1 + m_1)\,\Sigma PV[S_j] - \Sigma PV[C_j] = 0$

where $m_1 = -(\Sigma PV[C_j] / \Sigma PV[S_j]) - 1$

$= -(-91.77/79.32) - 1$

$= 1.157 - 1$

$= 0.157$ or 15.7%

The optimum mark up is 15.7%

Table 9. Modified – Cumulative-Cash Flow Schedule Revised

Item	End of Month										% of Total Cost
	0	1	2	3	4	5	6	7	8	9	
(a) Cumulative total cost	3.3	21.9	46.4	80.3	96.0	100.0					100.0
(b) Less Head Office Overheads, etc.	(0.8)	(1.5)	(2.1)	(2.7)	(3.4)	(4.2)					(4.2)
(c) Cumulative Chargeable Costs	2.5	20.4	44.3	77.6	92.6	95.8					95.8
(d) Billing Policy factor	1.0	1.0	1.0	1.0	1.0	1.0					1.0
(e) Cumulative billable cost (e=c.d)	2.5	20.4	44.3	77.6	92.6	95.8					95.8
(f) Less Retention 10%	(0.25)	(2.04)	(4.43)	(7.76)	(9.26)	(9.58)					(9.58)
(g) Cumulative "Payments before markup" due	2.25	18.36	39.87	69.84	83.34	86.22					86.22
(h) Cumulative "Payments before markup" received	-	-	-	-	2.25	18.36	39.87	69.84	83.34	95.80	95.80

Table 10. Determination of Optimum Markup (Revised)

End of month j	PV Factor @ 3.5% P/F, 3.5%, j	Cash outflows (Total cost for the following month) as % of total cost of project. All negative		Cash inflows (Payments before markup received) as % of total cost of project	
		$C_j = a_j - a_{j-1}$	PV[C]	$S_j = h_j - h_{j-1}$	PV[S]
(1)	(2)	(3)	(4)	(5)	(6)
0	1.000	3.30	3.30	-	-
1	0.966	18.60	17.97	-	-
2	0.934	24.50	22.88	-	-
3	0.902	33.90	30.58	-	-
4	0.871	15.70	13.67	2.25	1.96
5	0.842	4.00	3.37	16.11	13.56
6	0.814	-	-	21.51	17.51
7	0.786	-	-	29.97	23.56
8	0.759	-	-	13.50	10.52
9	0.734	-	-	12.46	9.15
	ΣC_j	- 100.0	- 91. 77		
	ΣS_j			95.80	75.99

NPV (3.5%, 9 mo) $= (1 + m_j)\Sigma PV[S_j] + \Sigma PV[C_j] = 0$

Where $m_j = -\{\Sigma PV[C_j]/\Sigma PV[S_j]\} - 1$

$= -(-91.77/75.99) - 1$

$= 1.208 - 1$

0.208 or 20.8%

The **optimum mark** up is 20.8%

Determination of the Minimum Acceptable Price (Revised)

Total Cost of Project	¢359,000,000.00
Optimum markup @ 20.8%	74,672,000.00
Contract price before bond premium	¢433,672,000. 00
Bond	869,100.00
Minimum acceptable Price (MAP)	¢ 434,541,100.00

CONCLUSION

It was realized that there was some level of adjudication before tenders are finalized. Participation by private consultants was evident since contractors normally do not employ qualified personnel as members of staff to undertake mark-up decisions. Recovery of Head office overheads was either through markups or charged as cost items and Ghanaian building contractors, from the analysis, were found not to use mathematical or statistical models to determine markup. In their forecast of cash flow at pretender stage. Ghanaian building contractors also do not use cost and value curves. Building contractors however, from the studies, appreciate the time value of money in markup determination. The analytical framework put forward also suggests that a significant rank correlation exists between classes D1 and D2 building contractors. There is therefore not much difference in markup policies of the two classes of building contractors. The optimum markup for construction projects in Ghana is a function of cash flow and the required rate of return. As a result, the Fair and Reasonable Markup (FaRM) pricing model is very suitable in establishing the optimum markup for construction projects in the present competitive environment in the Ghanaian building industry. This also leads to the determination of the Minimum Acceptable Price (MAP) for a project, a price below which the contractor cannot accept the project.

References

Amoa-Mensah, K. (1995), "Building Estimating Manual for West African Construction Practice", 2nd Edition, Parcom Ghana Ltd., Kumasi.

Ashley, D.B., (1977), *Construction Project risk Sharing. Technical report No. 220*, The Construction Institute, Department of Civil Engineering, Stanford University.

Bacarreza, R.R (1973), *The Construction Project Markup Decision under Conditions of Uncertainty*, Technical report 176, the Construction Institute, Department of Civil Engineering, Stanford University, Stanford, California, June 1973, 156p.

Buchan, R.D, Fleming, F.W and Kelly, J.R (1995), *Estimating for Builders and Quantity Surveyors*, Thompson Litho Ltd., Scotland.

Clough, R.H, (1975) *Construction Contracting*, 3rd Edition, John Wiley and Sons, New York.

Detr, (1998), *Rethinking Construction*, The Report of the Construction Task Force to the Deputy Prime Minister, John Prescott, on the scope for improving the quality and the efficiency of UK construction-forwarded by Sir John Egan. nttp:// www.construction.detr.gov.uk/cis/rethink/ index.htm

Deponai, J.M and Grubb, N (1980), *The Wages of Risk: Determining Fair and Reasonable Profit Objectives*, Technical report P-109, U.S Army Construction Engineering Research Laboratory,August 1980, 72p.

Farid, F and Boyer, L.T (1985), *Fair and Reasonable Markup (FaRM) Pricing model*, Journal of Construction Engineering and Management, Vol. III, No. 4, December 1985.

Farid, F and Boyer, L.T, (1981), *Construction Pricing Practices and Objectives of the firm*, Proceedings of the CIB (W – 65) International Symposium on Organization and Management of Construction, Dublin, Ireland, July 1981.

Fondahl, J.W and Bacarreza, R.R (1972), *Construction Contract Markup Related to Forecasted Cash flow*, Technical Report 161, The Construction Institute, Department of Civil Engineering, Stanford University, Stanford, California, November 1972, 122p.

Gitman, L.J., (1994), *Principles of Managerial Finance*, 7th Edition, Harper Collins College Publishers, New York.

Heng Li, (1996), *Neural network models for intelligent support of mark-up estimation*, Submitted Paper 3, The Department of Civil Engineering, Monash University, Caulfiled 3145, Australia, 1996, pp. 1, 2, 69-81.

Kish, L (1965), *Survey Sampling*, John Wiley &Sons Inc. New York.

Kotler, P., and Armstrong, G., (1996), *Principles of Marketing*, 7th Edition, Prentice-Hall, New Jersey.

Lucey, T., (1996), *Quantitative Techniques*, 5th Edition, DP Publications, London.

Shash, A.A and Abdul-Hadi, N.H (1992), *Factors affecting a contractor's mark-up size decision in Saudi Arabia*, Construction Management and Economic Journal, 10, pp. 415-429.

Shash, A.A and Abdul-Hadi, N.H (1993), *The effect of contractor size on mark-up size decision in Saudi Arabia*, Construction Management and Economic Journal, 11, pp. 421-429.

Stevens, J., (1996), *Applied Multivariate Statistics for the Social Sciences*, 3rd Edition, Lawrence Erlbaum Associates., New Jersey.