PRICING STRATEGY IN THE INDONESIAN CONSTRUCTION INDUSTRY

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ABSTRACT

Issues related to pricing strategy in the Indonesian construction industry are covered, including problems of current pricing strategy in construction, exploration of pricing strategies with a market-based approach, and survey findings of the top Indonesian contractors regarding their current pricing practices and the applicability of market-based pricing strategy models developed by Mochtar and Arditi. Comparisons with similar survey findings of the top U.S. contractors are conducted whenever possible. In conclusion, the belief that current pricing strategy in construction is predominantly cost-based is confirmed by the survey findings; indeed, in setting the markup, most contractors rely on subjective assessment of the competition. Using simulated bidding scenarios, it is discovered that Indonesian contractors tend to be more market-based as they know more about the owner's characteristics, competitors' characteristics, and market demand. Consequently, the implementation of bidding procedure proposed by Mochtar and Arditi is supported. To maximize the benefits of market-based pricing strategies, the bidding procedure change should be explored by all parties involved in the Indonesian construction industry.

Keywords*: Cost-based pricing, market-based pricing, pricing variables, bidding procedure.

INTRODUCTION

In setting project prices, construction companies have to meet two requirements to be successful. First, the prices have to reflect sufficient profitability for the company to conduct business. Second, the prices have to reflect sufficient value to the customers for them to engage in purchase transactions. Both conditions have to be met to make it viable for the producer and buyer to mutually benefit from the transaction. Either one without the other will likely result in an aborted sale. Price is one element of marketing mix that produces revenue; the other elements (product, place/distribution, and promotion) produce costs. Price is also one of the most flexible elements of the marketing mix, in that it can be changed quickly, unlike product features and subcontractor/supplier commitments. The number one problem encountered by most marketing executives is price competition. Yet many construction companies do not handle pricing well. There are at least four common mistakes made by marketing executives [1] if one transposes to the construction industry.

First, pricing is too cost oriented. Second, once an offer is made, price is not revised to capitalize on market conditions or to feud off competitive pressures. Third, price is not set as an intrinsic element of a market-positioning strategy. And fourth, price is not adjusted enough for different clients, project types, amount of work at hand, equipment ownership, etc.

There are basically two extreme pricing strategies: cost-based pricing and market-based pricing [2], consequently any other pricing strategy is always in between these two extremes. Cost-based pricing starts by establishing the total cost of making a product. The product is then sold with additional cost-based markups, commonly a desired profit. There are two problems with this pricing logic. First, it is possible to grossly underprice a product using cost-based pricing and forgo even greater levels of profitability. The second possible consequence of cost-based pricing is overpricing. Since the price is set based on internal cost and margin requirements, the price that results could be too high or too low relative to competing products of comparable quality and reputation. Had the pricing started with the market (customer, competitors, and product position), a business would know what cost reductions would be

needed to achieve a desired level of profit. And if those cost targets could not be met at the market-based price, then perhaps an alternative positioning strategy would have to be developed. Or perhaps the project should not be pursued since the profit potential is not likely to be achieved. However, there are conditions under which cost-based pricing does make sense and needs to be used: in commodity markets where competitors face the same cost of supply; and in competitive bidding markets, where pre-qualified bidders are selected on the basis of low price [2]. A review of pricing strategies both in general and in construction can be found in [3].

This paper presents several issues related to pricing in construction. First, problems with current pricing strategies in construction are explored. Second, a pricing strategy with a market-based approach is discussed. Third, survey findings of current pricing practices and findings related to the applicability of the proposed strategy of the top Indonesian contractors are presented. Comparisons with survey findings of the top U.S. contractors [4] are presented whenever possible. The comparisons are justified because they are both the top contractors in each country, so that similar characteristics and responses are expected. Finally, conclusions are drawn and recommendations are made regarding pricing strategy in the Indonesian construction industry.

PRICING IN CONSTRUCTION

The construction industry in most countries in the world is one of extreme competitiveness, with high risks and low margins of profit when compared to other areas of the economy. Consequently, pricing is one of the most important aspects of marketing in construction. But unlike in other industries, transactions and contracting in construction are conducted through the competitive bidding process, so that pricing mostly takes place in the bidding process. Currently, the pricing approach used in construction is cost-based. This strategy is commonly used in the U.S. construction industry [4]. The typical procedure in cost-based pricing involves estimating the project cost, then applying a markup for profit. Many researchers propose bidding strategies based on this approach [5,6,7,8,9,10,11,12]. There are however problems with this pricing logic [2].

Market-based pricing, developed mostly in the context of manufacturing industries, is an alternative strategy. There are models published by researchers concerning bidding strategies in the construction industry [13,14,15, 16,17,18,19] that, to a certain extent, include market information. However, the use of these models in the industry is very limited because most of these bidding strategy models require sensitive information about competitors, such as their minimum and maximum markup, and some of them require sensitive information about customers/owners; most of the time this information is not readily available.

PROPOSED PRICING STRATEGY MODELS IN CONSTRUCTION

Considering the problems with a cost-based strategy model and the benefits of more market oriented concepts, a series of market-based pricing models are developed for use in the construction industry [4]. For clarity, the models will be summarized as the followings, Model 1 is a purely cost-based pricing strategy model. The typical procedure in cost-based pricing involves estimating the project cost based on project documents (drawings and specifications), then applying a markup for profit.

Model 2, a hybrid-pricing model is a variation of the purely cost-based pricing approach. The cost optimization process in this model involves adjusting the estimated costs to fit the price range allowed by the market. In this model, detailed project cost estimating tasks are performed independently of market data collection. A decision is then made whether to bid or not to bid, based on whether the company can achieve cost levels that are within the market price range. Once a decision to bid is made, the risk policy of the company is decided. The company could decide wether to skim or penetrate the market. Skimming involves pricing the bid offer relatively higher than what the market would allow based on the belief that the company enjoys competitive advantage over the other bidders in terms of delivering the owner's most important requirements and providing the owner with best value. Skimming aims to maximize a company's profit. On the other hand, penetration is the opposite of skimming. Penetration involves keeping the profit margin deliberately and consistently lower than the market standard in order to outbid competitors already entrenched in a particular sector of the industry. This policy aims at penetrating a sector for the sake of securing a foothold in that sector even though it is known that the project

will generate minimal profit or maybe a small loss.

Model 3 is another version of a hybrid-pricing model. The main information of this model is market data collected through marketing intelligence so that a cost target can be set based on the market price range. Approximate cost estimates are calculated based on historical data and bidding documents. Cost analysis and adjustments are performed to optimize the cost and see if it fits within the market price range. Finally a decision to bid or not to bid the project is made.

Model 4 is a purely market-based pricing model. The main information used in this model is market data collected through marketing intelligence. This model suggests that the cost estimating function is not necessary at all. The decision is always to bid the project, fully based on collected market information through marketing intelligence. Cost analysis and adjustment are performed only after winning the project, before the construction phase begins. The big assumption of Model 4 is the belief that the company will always be able to find ways and methods to construct the project below the market price with a reasonable profit.

The pricing Models 1, 2, 3, and 4 constitute a pricing strategy spectrum from a purely cost-based strategy in Model 1 to a purely market-based strategy in Model 4. The market-based components of Models 2, 3, and 4 are largely dependent upon marketing intelligence functions in place in a company. A company with extensive marketing intelligence capability is expected to implement a more market-based pricing strategy in order to ensure a more competitive bid offer. A review of marketing intelligence in general and a discussion of the findings of a related survey conducted in the U.S. construction industry can be found in [20]. The findings of the survey conducted to explore the applicability of market-based pricing strategies in the Indonesian construction industry are discussed in the following sections.

THE SURVEY

A simulation model and a survey instrument were developed for the U.S. survey [4]. The questionnaire was adjusted to Indonesian condition and sent to the presidents/CEOs of Indonesian Contractors Association (Asosiasi Kontraktor Indonesia- AKI) members. AKI is an organization of Indonesian top contractors and has 122 members. It is believed that the nature of bidding (external variables), combined with the characteristics of a company (internal variables) lead to a specific pricing strategy. In this study, pricing strategy is represented by either the purely cost-based pricing model (Model 1), one of the hybrid models (Models 2 and 3) or the purely market-based pricing model (Model 4) presented in the previous section.

The eleven internal variables include: type of most projects performed (building or heavy), geographic location of projects (within or outside Java), work subcontracted (below or above 50% of contract value), marketing expenditure (below or above 2% of annual contract volume), annual contract volume, marketing orientation (competitive or negotiated contracts), type of client in most projects (public or private), equipment policy (owned or leased/rented), technological sophistication (high or low), level of experience (extensive or limited), and marketing intelligence capabilities (extensive or limited). These company characteristics are assessed in the first section of the survey.

The three external variables include the owner's characteristics (whether they are known or unknown), competitors' characteristics (whether they are known or unknown), and market demand (whether it is low or high). An owner's characteristics may include information about the owner's financial stability, reputation, history of litigation, potential for commissioning projects in the future, etc; the same type of information about the owner's consultants such as architects/engineers or construction management firms, is considered to be part of the owner's characteristics. Competitors' characteristics may include information about the names and number of bidders, their bidding history, financial situation, current workload, expansion plans, etc. Market demand includes not only current market conditions but also past trends and future projections in the company's sphere of activity and in related fields. A company has little or no control over external variables.

A simulation model composed of eight hypothetical bidding scenarios (HBSs) was used to represent the use of different pricing strategies under different conditions (external variables) and how these relate to company characteristics (internal variables). The description of the eight bidding scenarios is presented in Table 1. These eight scenarios consist of combinations of

three external variables that have a significant impact on the pricing approach adopted by a firm.

Table 1. Hypothetical bidding scenarios (HBSs)

External variables	HBS 1	HBS 2	HBS 3	HBS 4	HBS 5	HBS 6	HBS 7	HBS 8
Owner's characteristics	Unknown	Unknown	Unknown	Unknown	Known	Known	Known	Known
Competitors' characteristics	Unknown	Unknown	Known	Known	Unknown	Unknown	Known	Known
Market demand	Low	High	Low	High	Low	High	Low	High

In the second section, respondents were asked to indicate the most probable pricing approach they would use, in terms of the four Models 1, 2, 3, and 4, in each hypothetical bidding scenario. In the third section, the contractors were asked questions related to their current pricing strategy. This section includes the pricing strategy used, the assessment of markup, the decision-making concerning markup, and the importance of factors in their pricing strategy.

SURVEY FINDINGS AND DISCUSSION

Out of 122 questionnaires mailed, 15 or 12.3% were returned duly filled out. Based on the writer's experience, the 12.3% level of return is common for construction surveys in Indonesia.

The findings related to current pricing strategy practices are presented in Tables 2, 3, and 4. Table 2 presents data regarding pricing stra-tegies currently used by respondents. There were six choices of pricing strategy given to the respondents. These choices range from a purely cost-based pricing strategy that basically reflects Model 1 (rating: 1.0), to a purely market-based pricing strategy that basically reflects Model 4 (rating: 4.0). The four strategies in between these two extremes include a strategy between Models 1 and 2 (rating: 1.5), a strategy that corresponds to Model 2 (rating: 2.0), a strategy between Models 2 and 3 (rating 2.5), and a strategy that corresponds to Model 3 (rating: 3.0). Table 2 indicates that 13.3% of respondents are using pure cost-based pricing (Model 1) and that 80% use Model 2 or more cost-based approaches. The remaining three choices that are more market-based than Model 2 are being used by a total of 20%. The average pricing strategy is 1.90 on a scale 1 to 4 where 1= purely cost based and 4= purely market-based pricing. It appears that on the average a construction company performed a detailed cost estimate exactly the same procedure used in cost-based pricing, then a markup is set based

on the company's preferences and general market conditions with cost adjustments. This is very close to the pricing approach in Model 2 so that in setting the markup some market conditions such as competitors' past bids are taken into consideration. Most bidding models discussed by Mochtar and Arditi [3] are in line with this strategy. Compared to the finding of U.S. current pricing strategy, which is 1.62 [4], it shows that somehow Indonesian contractors are using more market-based strategy.

Table 2. Current pricing strategy

Pricing strategy (1)	Rating system (2)	Percent of respondents (3)	Rating (2)x(3) (4)
1. Detailed cost estimate is performed, then markup is set Based on company's preferences (Model 1).	1.0	13.3	13.3
2. Detailed cost estimate is performed, then markup is set Based on company's preferences and market conditions; No cost adjusments (Model1-Model 2).	1.5	20.0	30.0
3. As above, but with cost adjusments/optimization (Model 2).	2.0	46.7	93.4
4. Cost/markup is set based on market conditions; then Detailed cost estimate is made and then adjusted to Fit cost targets (Model 2-Model 3).	2.5	13.3	33.3
5. Cost/markup is set based on market conditions; then Rough cost estimate is made and then adjusted to Fit cost targets (Model 3).	3.0	6.7	20.1
6. Cost/markup is set fully based on market conditions;Costs are adjusted to fit targets only after the award of Contracts (Model 4).	4.0	0.0	0.0
Total		100.0	190.1
Average pricing strategy			1.90

A question in the survey explored pricing and markup assessment practices currently in place in responding companies. Besides the regular spreadsheets, there exist on the market soft-ware specially developed for pricing activities, such as CLAAS and Pricedex. CLAAS integrates price analysis, risk and trade analysis, and estimating. Pricedex manages and produces historical data on competitors' prices and information databases for products/services. In some other software, the user inputs infor-mation such as the number of competitors and competitors' minimum and maximum markups, then the software will generate a number of best price alternatives by using mathematical and statistical methods or fuzzy logic. Using special pricing software appears to be not popular in construction bid pricing; In line with the U.S. counterparts [4], the majority of Indonesian respondents (80% versus 55.6% in the U.S.) use spreadsheets, while only 13.3% (versus 33.3% for the U.S.) use special pricing software.

The markup estimation problem is a decision problem that is so highly unstructured that it is very difficult to analyze and formulate an adequate solution mechanism [8]. Table 3 presents data concerning types of markup decision assessment. It indicates that in deciding their markup the majority of contractors (66.7%) assess the competition. This assessment may include learning about who the competitors are, and how many of them there are. This way, a bidder can determine the severity of the competition, and based on that assessment, decides the most competitive markup for a particular bid. This finding agrees with Ahmad and Minkarah [10]. It is interesting to note that more than one quarter (26.7%) of respondents stated that they use intuition in deciding their magnitude of their markup. This finding also agrees with Ahmad [21] and Ahmad and Minkarah [10]. The usual practice is to make bid decisions on the basis of imtuition, derived from a mixture of gut feeling, experience, and guesses [21]. Even though "a constant percentage that does not change from project to project" strategy is only used by 6.7% of respondents, this strategy seems to have worked in those cases. In the U.S., one respondent commented that they have been using such strategy for almost 40 years [4], and that they survived in Engineering News Records' top 400 U.S. contractors [22].

Table 3. Markup Decision Assessment

Types of assessment	Respondents as percentage	
	Indonesia	US
Intuition	26.7	50.5
Probability/mathematical models	26.7	14.3
Empirical models	46.7	24.2
A constant percentage that does not change	6.7	9.9
An assessment of the competition	66.7	60.4

As seen in Table 4, the five most important factors in Indonesian respondents' current pricing strategy are financial goals of company, owner's characteristics, expected future project from the owner, competition, and need for work with respective average scores of 4.33, 4.20, 4.13, 4.13, and 4.00, on a scale of 1 to 5 where 1= least important and 5= most important. Three of those five factors are in agreement with the U.S. finding [4]:

- de Neufville et al. [11] believe that in pricing their bid, contractors are actually maximizing the monetary value of the project value. Consequently, the financial/monetary goals of a company are important enough to be maximized along with other utility measures in their models. It seems that this point of

view is confirmed by respondents in this survey, who rank financial goals in the first order of importance with an average score 4.33.

Table 4. Importance of Factors in Current Pricing Strategy

Factors	Average score	
	Indonesia	U.S.
Company's strengths and weaknesess	3.53	**4.12** (3)
Need for work	**4.00** (5)	**3.97** (5)
Demand/economic conditions	3.87	3.67
Financial goals of company	**4.33** (1)	**4.13** (1)
Competition	**4.13** (4)	3.40
Owner's characteristics	**4.20** (2)	3.83
Owner's consultant characteristics	3.67	3.24
Project size/complexity	3.87	**4.13** (2)
Project location	3.53	3.76
Subcontractors' characteristics	3.27	3.19
Expected future project from the owner	**4.13** (3)	**3.97** (4)

Note:
- 1=least important; 5=most important
- Bolds show the top five ranks
- Numbers in parentheses show ranks

- A long term relationship with clients is a high priority issue in the Indonesian respondents' pricing strategy; the majority of respondents think "expected future project from the owner" is a very important factor, placing this factor third in the importance ranking with a score of 4.13 (tie with "competition" factor). The implication of this attitude is that bidders may price their bid substantially lower than "normal", with the hope of having the opportunity to show the quality of their work to the owner and to maintain a good relationship with the owner. In return, the contractors hope the owner will award them other projects in the future or at least recommend them to other clients.
- A company's need for work is the fifth important factor in the company's pricing strategy with a score of 4.00. With such a high rank, this factor implies that companies with a desperate need for work may price their bids way lower than "normal". Owners should be aware of it.

Findings related to simulated bidding situations are presented in Tables 5 and 6. Contingency analysis was conducted to explore the strength of the relationship between internal variables and pricing strategy in different bidding scenarios. Table 5 indicates that most coefficients are not statistically significant at $\alpha = 0.05$. Only one coefficient is statistically significant, namely "annual contract value" in HBS 7 (known owner's and competitors' characteristics and low market demand). It is difficult to interpret this finding. Interestingly, the bottom

three rows in Table 5 also indicates that, as predicted, the average pricing model and its ranges preferred by respondents are mostly changing from less market-based to more market-based as one goes from HBS 1 to HBS 8 (from 1.5532 to 3.0635- except for HBS 5). Pricing Models 1, 2, 3, and 4 are like a spectrum of pricing strategy from pure cost-based strategy (Model 1) to pure market-based strategy (Model 4). In order to find the most probable pricing model used for a certain dependent variable, v in each hypothetical bidding scenario, average analysis is performed. The average model, AM_{vs} of the pricing strategy for each hypothetical bidding scenario,s (1 to 8) for internal variable, v (1 to 11) is calculated using the following formula:

$$AM_{vs} = \frac{\sum_{m=1}^{4} m.M_{ms}}{\sum_{m=1}^{4} M_{ms}} \qquad (1)$$

where M_{ms} is number of respondents using pricing Model m (1 to 4) in scenario s. Finally, to find the most probable pricing approach used in each hypothetical bidding scenario s, WM_s, a weighted-average analysis is performed. The contingency coefficients, C_{vs} are used as the weight of each average model, AM_{vs} in scenario s obtained. The use of contingency coefficients as the weight of each average model is justified because the contingency coefficients describe the strength of association between each internal variable and the pricing strategy, in this case the average model in scenario s. The calculation is as follows:

$$WM_s = \frac{\sum_{v=1}^{11} C_{vs}.AM_{vs}}{\sum_{v=1}^{11} C_{vs}} \qquad (2)$$

where 11 is the number of internal variables. It can be seen in Table 1 that HBSs 1 to 8 constitute a spectrum from unknown to known owners' and competitors' characteristics.

It can be said that the more known the owner's and competitors' characteristics, the more market-based the pricing strategy used (even in HBS 8 where market characteristics are known, average pricing strategy is 3.0635). This finding contradicts the traditional belief in construction that pricing is a one-strategy phenomenon, i.e., that all contractors use approximately the same strategy. The fact that respondents used a different pricing strategy in each of the bidding scenarios developed in this research is proof

that the traditional belief is not true. Contractors tend to be more market-based as they know more about their clients and competitors.

Table 5. Contingency coefficients between internal variables and pricing strategy in hypothetical bidding scenarios (HBSs)

Internal variables	Pricing strategy in								
	HBS 1	HBS 2	HBS 3	HBS 4	HBS 5	HBS 6	HBS 7	HBS 8	Average
Type of project performed	0.1100	0.5403	0.4989	0.5178	0.4313	0.5345	0.6083	0.3536	04493
Geographic location of most projects	0.2774	0.5571	0.4025	0.3536	0.4129	0.4588	0.5861	0.5571	0.4507
Work subcontracted on average job	0.2351	0.3713	0.2199	0.4489	0.2828	0.2977	0.3846	0.4460	0.3358
Marketing expenditure	0.5906	0.4892	0.5252	0.3446	0.3756	0.5377	0.5423	0.4892	0.4868
Annual contract volume	0.3536	0.3388	0.3815	0.5278	0.4537	0.5976	**0.6447**	0.3536	0.4564
Marketing orientation	0.3430	0.4042	0.1322	0.2165	0.0576	0.3806	0.4264	0.3756	0.2920
Type of client in most projects	0.2351	0.3713	0.4523	0.3752	0.2828	0.1395	0.4714	0.4892	0.3521
Equipment policy	0.3974	0.4523	0.4006	0.4909	0.0576	0.3430	0.3627	0.4042	0.3636
Technological sophistication	0.2351	0.4460	0.4794	0.3446	0.2828	0.3855	0.1556	0.5652	0.3618
Level of experience	0.2351	0.4460	0.2199	0.3446	0.4729	0.5606	0.2615	0.5652	0.3882
Marketing intelligence capabilities	0.2351	0.4892	0.2199	0.3142	0.2828	0.4978	0.2664	0.4892	0.3493
Average pricing strategy	1.5532	1.9077	2.1689	2.1958	1.9778	2.2635	2.5124	3.0635	2.2053

Note: HBS refers to Table 1; box and bold face denote significant association at 95%

Table 6 presents data regarding the pricing strategy used under conditions characterized by external sub-variables. The average is found by calculating the average of respondents' pricing strategy assessed in the second section of the simulation model explained in previous section for respective external sub-variables. T-tests are conducted to test the hypotheses of average differences. The results presented in Table 6 indicate that all hypotheses are supported at 95%. As expected, when information about the owner's and competitors' characteristics is not available, contractors tend to use a less market-based pricing approach than when information about the owner and competitors is readily available. Also as expected, in an environment characterized by low market demand (high competition, more secretive practices and less access to market information), contractors tend to use a less market-based pricing approach than in an environment characterized by high market demand (less competition, more open practices and more access to market information).

Table 6. Pricing Strategy in Conditions Characterized by External Sub-variables

External Variables	Average	Range	
		Lower	Upper
1. Owner's characteristics			
1.1. Unknown	m1= 1.9791	1.4895	2.9895
1.2. Known	m2= 2.5056	1.7528	3.2528
H1: m1 < m2	Yes		
2. Competitors' characteristics			
2.1. Unknown	m1= 1.9556	1.4778	2.9778
2.2. Known	m2= 2.5133	1.7567	3.2567
H1: m1 < m2	Yes		
3. Market demand			
3.1. Low	m1= 2.1085	1.5542	3.0542
3.2. High	m2= 2.3700	1.6850	3.1850
H1: m1 < m2	Yes		

Note: bold denotes significant at α= 0.05

In the light of the hypotheses associated with owner's characteristics and type of client variables that are found to hold true at 95%, it can be stated that the way construction clients organize their project letting procedures (bidding) is very important for a contractor's pricing strategy decisions. To allow for a more market-based approach to pricing, a drastic departure is highly recommended from the current bidding process to the proposed bidding process [4]. The proposed bidding process is a modification of the bidding process used by NASA and discussed by [23]. In the current bidding process, final proposals are submitted right after bidding invitation, project explanation, and field visits. Evaluation and contract award constitute the next events. Most clients use the lowest bid evaluation system. No clarification, correction, or negotiation of the bid offer takes place. In contrast, in the proposed bidding process, the best and final offer is submitted only after clarification, correction, and negotiation; marketing intelligence actions can be conducted by the bidders until the best and final offer event. Final evaluation using the best value system is the next event. The best value for each client may be different depending on the client's most important requirements. The most important requirements can be identified and assessed by contractors through their intelligence activities. Even though the proposed alternative may involve a longer and more complex process, by applying the proposed bidding process, clients allow contractors an opportunity to use a more market-based pricing strategy; in turn clients get the best price and the best contractors for their projects [4].

CONCLUSION

The conclusions and major findings of this research and the associated recommendations are presented in the following paragraphs:

- Current pricing strategy. In the study presented in this paper, pricing strategy models developed by Mochtar and Arditi [4] are used. It is generally believed that pricing strategy in construction makes use of predominantly cost-based approaches. This belief is confirmed by the survey findings. The current average strategy used by respondents (1.90 in a continuum where 1= purely cost-based and 4= purely market-based strategy) is a strategy where first a detailed cost estimate is performed, then markup is set based on the company's preferences and market conditions with cost

adjustments. It is very close to the hybrid pricing approach so that in setting the markup some market conditions such as competitors' past bids are taken into consideration, and optimization of construction methods are conducted. In setting their bid offer, most contractors rely on subjective assessment on the competition; most contractors do not use special pricing software. The pricing decisions would be much improved if they not only considered subjective assessment, but also up-to-date information about all relevant market characteristics (owner and competitor characteristics, and demand level). Special pricing software such as those that organize market price databases and perform price analysis could improve pricing decisions.

- Association between variables and pricing strategy. No general trends were found in contingency table analysis, except that the average pricing strategy consistently changes from less market-based to more market-based as one goes from HBS 1 (unknown owner and competitor characteristics and low demand) to HBS 8 (known owner and competitor characteristics and high demand). It can be concluded that contractors practice more market-based pricing when owner and competitor characteristics are available even though they rely extensively on their subjective competition assessment. When considered alongside the external variable owner's characteristics that was also found to be significantly related to pricing strategy, it can be stated that a change in bidding procedures towards the system proposed by Mochtar and Arditi [4] is supported, because it could allow for the implementation of more market-based strategies. If clients' handling of the bidding process is changed in the direction of the proposed bidding practice, it is not impossible for contractors to use a strategy that is close to Model 4 (a purely market-based strategy). The proposed bidding practice has actually been used successfully in electronic and computer procurement using competitive bidding method by NASA [23], where as a result, most contractors are using pricing strategies that fall between Models 3 and 4.

Finally, a shift from the traditional cost-based pricing strategy to a more market-based pricing strategy is anticipated in the new millennium where markets are expected to be more globalized, competition to grow fiercer, and

breakthrough developments in information technologies to rapidly emerge. This shift is dependent on changes in the bidding environment. Market-based pricing is a promising solution that can overcome the challenges in marketing construction services in the future and that can maximize the benefits derived by all the parties involved in construction projects.

REFERENCES

1. Kotler, P. *Marketing Management Analysis, Planning, Implementation, and Control*, 9th edition, Prentice Hall, New Jersey, 1997.

2. Best, R.J. *Market-based Management Strategies for Growing Customer Value and Profitability,* Prentice Hall, New Jersey, 1997.

3. Mochtar, K. and Arditi, D. Alternate Pricing Strategies in Construction, *Journal of Dimensi Teknik Sipil*, 2(1), Petra Surabaya University, Surabaya, Indonesia, 2000, pp.56-64.

4. Mochtar, K. and Arditi, D. Pricing Strategy in the US Construction Industry, *Construction Management and Economics*, Spon Press, 19 (4), 2001, pp. 405-415.

5. Fayek, A. Competitive Bidding Strategy Model and Software System for Bid Preparation, *Journal of Construction Engineering and Management*, ASCE, 124(1), 1998, pp. 1-10.

6. Ioannou, P.G. and Leu, S. Average-bid Method - Competitive Bidding Strategy, *Journal of Construction Engineering and Management*, 119(1), ASCE, 1993, pp. 131-147.

7. Paek, J.H., Lee, Y.W., Ock, J.H. Pricing Construction Risk: Fuzzy Set Application, *Journal of Construction Engineering and Management*, ASCE, 109(4), 1977, pp. 743-756.

8. Moselhi, O., Hegazy, T., and Fazio, P. DBID: Analogy-based DSS for Bidding in Construction, *Journal of Construction Engineering and Management*, ASCE, 119(3), 1993, pp. 466-479.

9. de Neufville, R. and King, D. Risk and need-for-work premiums in contractor bidding, *Journal of Construction Engineering and Management*, ASCE, 117(4), 1991, pp. 659-673.

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

11. de Neufville, R. and Lesage, Y., and Hani, E.N. Bidding Models: Effects of Bidders' Risk Aversion, *Journal of the Construction Division*, ASCE, 103(1), 1977, pp. 57-70.

12. Carr, R.I. and Sandahl, J.W. Bidding Strategy Using Multiple Regression, *Journal of the Construction Division*, ASCE, 104(1), 1978, pp. 15-26.

13. Griffis, F.H. Bidding Strategy: Winning Over Key Competitors, *Journal of Construction Engineering and Management*, ASCE, 118(1), 1982, pp.151-165

14. Ioannou, P.G. Bidding Models Symmetry and State of Information, *Journal of Construction Engineering and Management*, ASCE, 114(2), 1988, pp. 214-232.

15. Carr, R.I. General Bidding Model, *Journal of the Construction Division*, ASCE, 108(4), 1982, pp. 639-650.

16. Carr, R.I. Competitive Bidding Opportunity Costs, *Journal of Construction Engineering and Management*, ASCE, 113(1), 1987, pp. 151-165.

17. Benjamin, N.B.H. and Meador, R.C. Comparison of Friedman and Gates Competitive Bidding Models, *Journal of the Construction Division*, ASCE, 105(1), 1979, pp. 25-40.

18. Fuerst, M. Bidding Models: Truths and Comments, *Journal of the Construction Division*, ASCE, 102(1), 1976, pp. 169-177.

19. Wade, R.L. and Harris, R.B. LOMARK: a Bidding Strategy, *Journal of the Construction Division*, ASCE, 102(1), 1976, pp. 197-211.

20. Mochtar, K. Marketing Intelligence and Pricing Strategy in Construction, *Proceeding of Fourth Semi-Annual Graduate Research Conference*, Illinois Institute of Technology Department of Civil and Architectural Engineering, Chicago, 1999, pp. 8-23.

21. Ahmad, I. Decision Support System for Modeling Bid/no Bid Decision Problem, *Journal of Construction Engineering and Management*, ASCE, 116(4), 1990, pp. 595-608.

22. ENR the top 400 contractors, *Engineering News-Record*, McGraw-Hill, May 25, 1998.

23. Flett, F. Business and Competitive Intelligence Course Manual, Federal Publications Seminars LLC, Alexandria, October 19-20, 1999.