Contractors' Bidding Behavior in First-Price Sealed Auctions for Construction Projects

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***Abstract*—Procurement of public construction projects generally adopts first-price sealed auctions to promote competition between bidders and reduce owner's cost. This paper presents an analysis for bidding behavior of contractors in public construction markets. The analysis utilizes real data representing the bid results of 1396 projects submitted for public construction projects in Jordan. Bidding data were classified depending on the type of project into: building construction, transportation, infrastructure, water, and electro-mechanical projects. The data includes also engineering design and/or engineering supervision projects. The analyzed behavior attributes are: 1) competition between bidders measured by number of bidders and the bid spread between the lowest two bidders; and 2) bidding variability measured by the coefficient of variation. The analysis revealed that number of bidders and bid spread depend on type of project advertised and market conditions. The variability of bidding results also is correlated with type of project. The performed analysis provide owners with an assessment of the efficiency of the competitive bidding process and can be used to identify weaknesses that need to be addressed in bidding regulations. Contractors can utilize the results to develop their bidding strategies to win profitable jobs.**

***Index Terms*—Bidding strategies, construction projects, contractors, first price auctions, sealed bids.**

I. Introduction

First-price sealed auction is the major procurement method for construction projects in both the private and public sector [1]-[5]. This method promotes competition between bidders to win the contract. Bidding regulations for public construction projects mandate the use of competitive bidding to award contracts in the governmental sector. Selection of this procurement method in the public sector is intended to: 1) select the most advantageous offer to the owner, 2) obtain the constructed facility at lower price to make the best use of the public money, and 2) provide equal opportunity for every qualified contractor to bid on the project. Using first-price sealed auction, construction projects are normally awarded to the lowest responsive and responsible bidder, where only one bidder wins the bid and the remaining bidders lose the invested time and effort in preparing bidding offers. Construction bidding received a lot of interest among researchers in construction management due to its vital role in project development and survival of contractors. Available studies have focused on either: 1) supporting contractors in taking the bid/no bid decision [6]-[12], or 2) studying contractors' bidding behavior to support owners in designing bidding requirements and contractors to increase their chances of winning the bid [13]-[17]. The majority of previous research efforts have focused on one or few parameters that affect bidders' behavior in competitive bidding. The objective of this paper is to augment available knowledge in bidding theory by providing empirical analysis that focus on bid opening results in public construction project in order to get a better understanding of the factors affecting bidders' behavior in the construction industry. This should prove to be useful to the owners as they set the bidding requirements and polices for their projects. Also, to the same extent, this will support contractors in their challenging objective of winning bids in this highly competitive industry. The next section will provide a brief review of literature followed by description of the data utilized in this paper. After that, the analyzed bidding behavior indicators will be discussed, and then the results and analysis performed will be presented.

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II. Literature Review

Azman [18] examined bid data for 195 public construction projects in Malaysia and reported that number of bidders depends on the project value and the distance between project site and the supply source. Azman [18] indicated that increasing the number of bidders, increases the intensity of competition and it reduces the bidding price. Sammoura and Elsayed [19] investigated the relationship between the number of qualified bidders and the bid price. The study used the ratio of the lowest price to the average bid price to represent the lowest bid price. The results of the analysis performed by Sammoura and Elsayed [19] showed that as the number of bidders increases, the lowest bid price (i.e. the ratio of the lowest bid price to the average bid price) decreases. The data used in the analysis were the bidding results of only 41 public road construction and rehabilitation projects in Lebanon. Banki et al. [15] presented a quantitative analysis of the impact of number of bidders on project bid prices, and reported that increasing the number of bidders will result in decreased project bid prices. Carr [16] developed a regression model to quantify the relationship between number of project bidders and competition in public projects and concluded that limiting the number of bidders will lead to an increase in project bid prices due to reduced competition. The analysis performed by Carr [16] was based on comparing the estimated project cost, actual bid price, and number of bidders who competed for that project. Hong and Shum [20] analyzed the bid results of construction projects awarded by New Jersey Department of Transportation (NJDOT) in the years

1989-1997, and reported that median project costs rise as number of bidders increases, which tips over the widely accepted economic perception that an increase in competition is always better to the owner. Drew *et al.* [5] developed a model that quantifies the impact of various types and sizes of construction projects and owner types on bidders' behavior and selection of the most appropriate mark-up level for the project. Drew *et al.* [5] reported that contractor's bidding behavior is significantly affected by client type and size of construction work.

Jayasena [21] examined the variability in bid results in the Sri Lankan construction industry. The study aimed at determining the project attributes that affect variability in bid prices. Jayasena [21] used the coefficient of variation to measure variability in bid prices. The analyzed data included 62 projects which limit the conclusions that can be drawn from the study. The results reveal that the average variability in bid prices measured by the coefficient of variation is about 16%. Jayasena [21] indicate that large variability in bid prices reflects market inefficiency. Large variations in bid prices suggest a high level of inefficiency in the market because an efficient market usually results in small fluctuations around an equilibrium price. The equilibrium price is fair for both the owner and contractor. Akiyama *et al.* [22] investigated the variability in Japan using a sample of 395 projects and reported an average coefficient of variation of 2.9%. Akiyama *et al.* [22] concluded that the bidding behavior of Japanese contractors is "sensible type" which enables contractors to price their bids near the successful bid price. Skitmore, M. [23] investigated the variability of submitted unit prices in U.S. and Europe and concluded that average coefficient of variation was in the range of 5-8.4 %. Skitmore, M. [23] indicated that the spread of submitted prices between bidders can be attributed to deliberate or accidental difference in bidders pricing strategies. Deliberate differences are due to workloads while accidental differences are due to uncertainty in estimating costs.

Bedford [14] evaluated bid and cost data from 218 public construction projects in Toronto and reported that increased contractor competition (i.e. high number of bids) and a large difference between the lowest bid and other bids are correlated to higher cost escalation. Zhu [4] investigated the rationality in assumptions implicit in bidding theory for construction projects, and concluded that the major problem is the unrealistic assumptions about rationality of bidders while it is well accepted outside economic circles that people's thoughts and behaviors are not strictly rational in the economic sense. Kim [3] investigated effects of risk attitude on competitive success in construction industry, and reported that risk attitude is dominant competitive characteristic of contractors.

III. Data Acquisition and Preparation

The data used in this paper represents the bidding results of 1396 advertised by the Ministry of Public Works and Housing (MPWH) in Jordan over the period from 2004 until 2015. MPWH is responsible for procuring public construction projects and therefore advertised projects include construction and maintenance for various types of public projects as well as procuring engineering services for the design and construction monitoring services for these projects. The total value of projects advertised, measured by the lowest received bid, during the study period is 2,989,719,159 Jordan Dinars (about 4.27 billion U.S. dollars). Average project value is 2,337,920 Jordan Dinars (about 3.29 million U.S. dollars).The acquired data was first classified depending on the type of project to the following categories: 1) building construction projects; 2) transportation projects; 3) infrastructure projects; 4); water projects; 5) electromechanical; 6) engineering design projects; and 7) engineering supervision projects. The available attributes for every project of the 1396 projects include: 1) submitted bid prices of all bidder to the project; 2) number of bidders; 3) location of the project; 4) type of project; and 5) date of bid opening.

IV. Bidding Behavior Indicators

A number of indicators can be used to analyze the bidding behavior in sealed auctions. The bidding indicators provide insight on the functioning of bid competition among contractors, and can be used to identify areas of weakness that needs to be addressed by bidding regulations. Contractors can also utilize the bidding indicators in order to develop their bidding strategies. The following behavior indicators are analyzed: 1) number of bidders; 2) bid spread; 3) coefficient of variation. The following paragraphs provide a brief description of those indicators.

A. Number of Bidders

Number of bidders is an important indicator of the bidding environment where increased number of bidders is an obvious indicator of increased competition among bidders to win the project. Owners and public bidding authorities signifies the importance of promoting competition in projects to ensure obtaining reasonably priced offers for the advertised projects. Procurement laws for public projects strongly discourage adopting bidding regulations that impose unnecessary restrictions on number of bidders for projects. Several studies indicate that increasing the number of bidders encourages more aggressive bidding to cope with the negative impact of the increase in the number of competitors on each bidder's probability of winning the contract[16], [19]. Number of bidders can be correlated with market conditions because number of bidders is expected to increase as number of advertised projects decrease.

B. Bid Spread

Bid spread in competitive bidding is defined as the difference between the lowest bidder and the second lowest bidder. This measure which is also called the winning margin is an important measure in first price sealed bidding. This difference is commonly named "Money left on the table" because it represents a foregone profit to the lowest bidder. Skimore *et al.* [24] investigated bid spread in competitive bidding and tried to correlate it with other project parameters such as contract size value and number of bidders in order to study their impact on the spread between the lowest two

bidders. Skitmore *et al*. [24] concluded that analysis provided overwhelming evidence that competitive bidding is dominated by inherent variability. Runeson [25] reported that as the number of bidders increase, the difference between the lowest bidder and the second lowest bidder decrease as a percentage of the estimated cost of the project. Also Park and Chapin [26] reported that bid spread decreases as number of bidders increases.

C. Coefficient of Variation

Coefficient of variation measures the variability of bidding results. Construction bidders are equally informed since they all get the same bidding documents, and they all supposed to do accurate cost estimating before submitting their bids. Contractors' bid level cost estimating is the highest level in construction cost estimating. Therefore analyzing the variability in bidding results using relative coefficient of variation can provide useful information regarding the accuracy of cost estimating or adequacy of scope definition in various project categories. The coefficient of variation is normalized by dividing the standard deviation of the submitted bids for any project over the mean of submitted bids for that project [21].

V. Results and Discussion

The performed analysis provides valuable information about the bidding behavior of contractors bidding for public construction projects and can be used to identify weaknesses that need to be addressed in new projects and provide indicators about the healthiness of the competitive bidding processes adopted in procuring public construction projects. The results are divided into four subsections that include: 1) statistics of the data utilized; 2) number of bidders, 3) bid spread, and 4) coefficient of variation.

TABLE I: Value of projects Advertised Over the Study Period

Year	Number of Projects	Total value of Projects (JD)	Average value of Projects (JD)
2004	66	136,771,862	2,072,301
2005	151	117,209,670	776,223
2006	157	223,119,386	1,421,143
2007	51	54,063,744	1,060,073
2008	187	699,065,339	3,738,317
2009	147	526,082,498	3,578,793
2010	13	48,653,303	3,742,562
2011	9	8,687,024	965,225
2012	9	11,535,150	1,281,683
2013	164	637,384,707	3,886,492
2014	271	305,071,387	1,125,725
2015	158	219,429,516	1,283,214

A. General Analysis

The analysis started with identifying the lowest bidder, the second lowest bidder, average of all bidders, and standard deviation of bids received. Table 1 illustrates the changes in yearly total value of projects advertised during the study period (2004-2015). The changes in total value of projects advertised over the twelve years demonstrates high growth in the market of public construction projects, and reflects the instability in this market represented by wide fluctuation in values of projects advertised over the study period. This variability represents serious risks to contractors, especially those who depend on public construction projects such as contractors working with infrastructure and transportation projects. Heavy construction contractors incur high overhead costs associated with the investment in construction equipment and the need to retain specialized workforce. The changes in total value of projects illustrate the sensitivity of the construction industry to the economic conditions. The effect of the economic crisis in 2007-2009 is obvious. Table I depicts the average value of the projects awarded each year to provide an idea about construction project size.

Table II displays the number and percentage of projects advertised of each project type in the analyzed data based on the number of projects in each project type relative to the total number of projects. As shown in the table, building construction projects accounts for 40% of the total projects with 558 building projects. The second highest type in the table is engineering supervision contracts with 307 projects which account for 22% of the total projects advertised. This reflects the reliance of the government on the engineering consultancy firms for project monitoring and engineering supervision of public construction projects. Table 2 illustrates average project value for each project type. Transportation and water projects have the highest average project values with averages of 5,976,891 and 819,817 JD respectively. Average project value for engineering services contracts illustrate that design of projects costs around 164,849 JD which represents around 5.2% of the construction cost while the engineering supervision costs on average 238,224 JD which represents around 7.5% of the construction cost. Those percentages where obtained after calculating average project value for all projects, excluding engineering services projects, which is found to be amounts to 3,163,311 JD.

TABLE II: Types of Projects in the Analyzed Data

Project Type	Number of Projects	Percentage	Average Project Value (JD)
Building Construction	558	40.0%	2,153,471
Transportation	175	12.5%	5,976,891
Infrastructure	47	3.4%	1,767,727
Water	110	7.9%	4,819,817
Electromechanical	13	0.9%	718,582
Engineering Supervision	307	22.0%	238,224
Engineering Design	186	13.3%	164,849
Total:	1396		

B. Number of Bidders

Number of bidders competing for a construction project is an obvious measure of competition because only one of the bidders will get the contract. The performed analysis includes studying the number of bidders in different types of projects advertised for public construction projects in Jordan. Fig. 1 illustrates the average number of bidders for each project category. It is interesting to see that professional engineering services like engineering design and engineering supervision have higher number of bidders compared to construction projects. This indicates that engineering consultancy services is highly competitive, and therefore owners will be able to

obtain competitive bids when procuring engineering services. For construction contracts, building construction contracts have the highest number of bidders with an average of 7.4 bidders. Transportation projects and water projects have less number of bidders with an average of 6.2 and 6.0 respectively. Electormechanical projects have the lowest number of bidders with an average of 5.6 which suggests that owners should evaluate bids submitted for such projects carefully to ensure the reasonableness of prices submitted for these projects. This result can be explained by the variation in the needed resources in various types of projects. Building construction projects are traditional projects that require low capabilities compared to highway projects therefore number of bidders in traditional projects was higher than big projects.

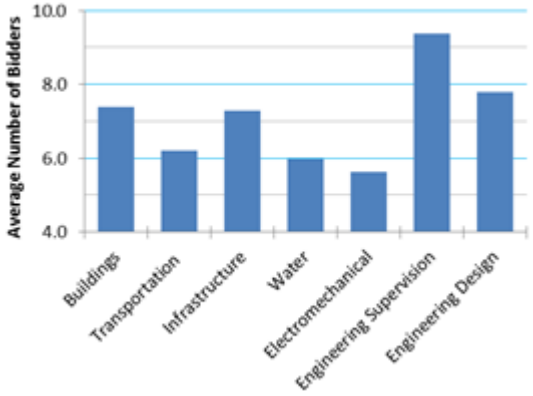

Fig. 1. Number of bidders according to project category.

Fig. 2 illustrates the change in average number of bidders over the study period (i.e. 2004-2015) and shows a significant variation in number of bidders over years where the average increased from 5.1 in year 2005 to 11.1 in year 2010. This fluctuation is an indication of the market situation and the prosperity and recession cycles in the construction industry. Fig. 3 shows the number of projects advertised over years. And illustrates that years 2010-2012 have the lowest number of projects over the study period. This explains the higher average number of bidders in those years. It is noteworthy that the years 2010-2012 followed the global financial crisis 2007-2009, and illustrates how public construction authorities responded to the crisis by reducing or even freezing investments in public projects. This illustrates the higher sensitivity of the construction industry to the economy cycles and governmental policies which in turn represent higher investment risks on contractors.

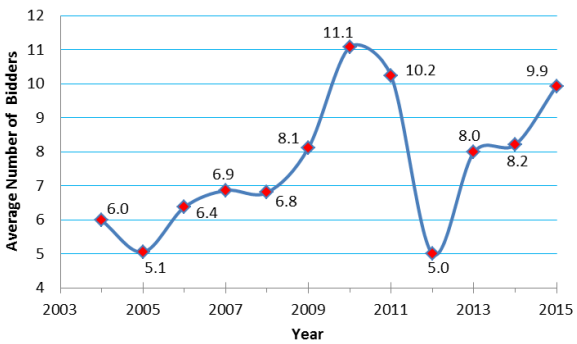

Fig. 2. Average number of bidders over years.

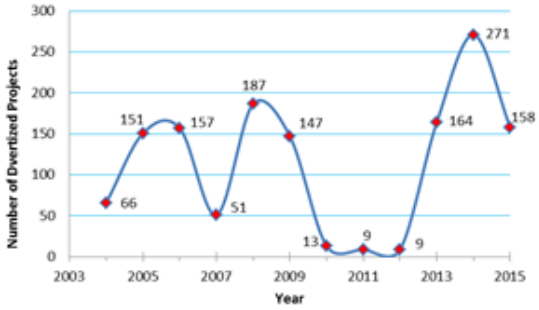

Fig. 3. Number of advertised projects over years.

Fig. 4 illustrates the relationship between number of bidders and average bid value of advertised projects. The figure suggests that there is no significant correlation between number of bidders and project value.

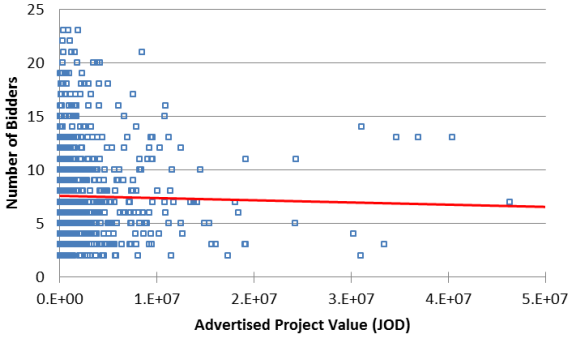

Fig. 4. Relationship between number of bidders and project value.

C. *Bid Spread*

The analysis of the difference between the lowest and second lowest bids, or bid-spread, in a first price sealed auctions is valuable for both owners and contractors. Bid spread provides an indication of mistakes in bids. It can be used to determine a justifiable amount of bid bond. Bid spread fluctuations can provide some insight into the consequences of non-traditional auction arrangements. The performed analysis includes the relationship between bid spread and different parameters. Fig. 5 shows the variations in average bid spread across the project categories analyzed. It is obvious that building construction projects has the smallest average bid spread which indicates that such projects are highly competitive and the scope of such projects is described clearly in bidding documents. Water projects have the highest average spread among other construction categories. The higher amount of bid spread in water projects warrants a serious attention from public officials as it reveals either low competition among bidders or inaccurate scope definition in bidding document or both. Owners need to put additional efforts to better describe the scope of work, and need to ensure that a dependable owner's cost estimate is developed for water projects in order to ascertain the appropriateness of bid prices submitted by the lowest bidder. Engineering design projects have a notable high bid spread which also warrants serious attention to study the effectiveness of the competitive bidding process adopted for such projects. Fig. 6 shows variations in average bid spread over the study period. The wide variations in average bid spread support the sensitivity of this measure to market conditions, and suggest that bid

spread can be used as a measure of competition in the construction industry where higher values reflect reduced competition and low values associated with higher competition in the market.

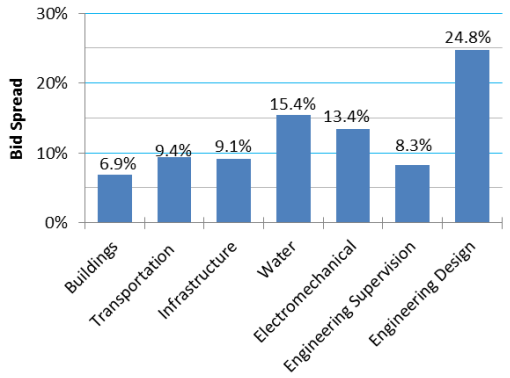

Fig. 5. Bid spread for different categories of tenders.

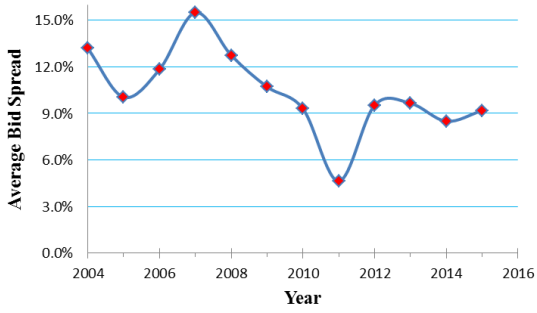

Fig. 6. Change in average bid spread over the study period.

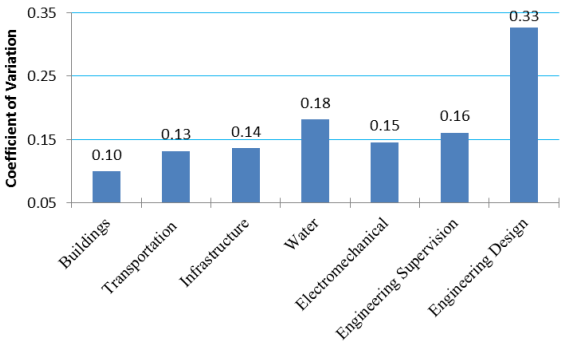

Fig. 7. Average coefficient of variation for different categories of tenders.

D. *Coefficient of Variation*

Coefficient of variation is an indication of the accuracy of cost estimating performed by competing bidders and the appropriateness of scope definition in bidding documents. The average coefficient of variation for all projects in the data was 15.6%. This value is comparable with the 16% result reported by Jayasena [21]. Fig. 7 illustrates the average coefficient of variation for different categories of projects advertised. It is obvious that building construction projects have the lowest coefficient of variation which reflects higher market efficiency in this type of projects. Water projects have the highest variability among construction projects which reflects inefficiency in the market. Public bidding authorities should ensure adequate scope definition in these projects, and should encourage higher competition in this type of projects through bidding regulations. Bids for engineering services showed significant differences in bids variability. While engineering supervision have an average coefficient of variation of 16%, engineering design projects have an average variability of 33%. The engineering supervision variability is comparable with construction bids' variability. The variability in design projects is strikingly high and reflects inefficiency in the market, and suggest that competitive bidding might not be the best option for procuring design services. Bidding officials should investigate thoroughly reasons behind this variability and adopt measures to reduce variability in such bids submitted for design projects.

Fig. 8 represents the change in average coefficient of variation over the study period. The results indicate that bids' variability is associated with competition in the market. Years 2010-2012 showed sharp fluctuations in average coefficient of variation which reflects higher level of instability in the market due to the sharp reduction in advertised projects. The results illustrate the significant role of public construction projects in the construction industry.

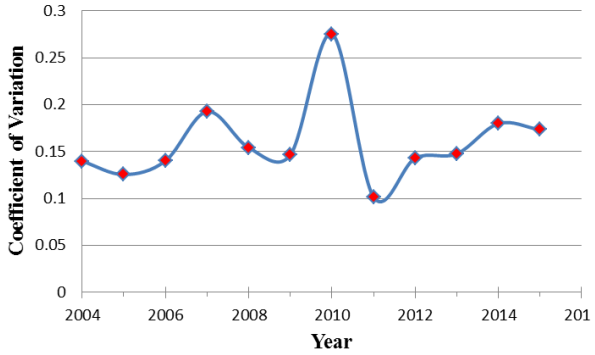

Fig. 8. Average coefficient of variation across the study period.

VI. Conclusion

This paper examined the competitive bidding market for public construction projects in Jordan. The analyzed data represented the bidding results of public construction projects advertised over a period of 12 years from 2004 to 2015 in Jordan. The analysis performed started with examining the number of bidders competing for various project types. The analysis evaluated the impact of market conditions as well as project value on the number of bidders. The performed analysis investigated factors that affect bid spread in all projects such as type of project, and market situation. The results indicated that type of project affects bid spread where the highest average spread was found in "engineering design" projects, while the lowest bid spread was found in "building construction projects". The variability in the submitted bids was analyzed and compared with international practice. The coefficient of variation was used to normalize the variability in all projects. The results revealed significant differences in bid variability among project types. Building construction projects have the lowest average variability whereas water projects have the highest average variability. Engineering design projects have high disparity in bidding results which suggest that this type of bidding is not the best option for procuring design services. The performed analysis should be useful to contractors and owners alike, and can contribute to a better understanding of contractors' bidding behaviors in

public construction arena based on data from real projects awarded for various types of construction projects.

REFERENCES

[1] S. Wamuziri and N. Abu-Shaaban, "Potential of reverse auctions in construction procurement," in *Proc. of the 21st Annual ARCOM Conference, University of London*, SOAS, Association of Researchers in Construction Management, 7-9 September 2005, vol. 1, pp. 611-619.

[2] A. Soo and B. L. Oo, "The effect of information feedback in construction bidding," *Australasian Journal of Construction Economics and Building*, vol. 10, no. 1/2, 2010. pp. 65-75.

[3] H. J. Kim, "The effects of risk attitude on competitive success in the construction industry," PhD Thesis, *Texas A&M University*, 2009.

[4] C. Zhu, "Rationality in bidding theory: A construction industry perspective," in *Proc. the BuHu 8th International Postgraduate Research Conference*, The Czech Technical University of Prague (CVUT), Czech Republic, vol. 2, 2008, pp. 257-264.

[5] D. S. Drew, H. P. Lo, and M. Skitmore, "The effect of client and type and size of construction work on a contractor's bidding strategy," *Building and Environment*, vol. 36, no. 3, April 2001, pp. 393-406.

[6] M. El-Mashaleh, "Empirical framework for making the bid/no-bid decision," *Journal of Management in Engineering, ASCE*, vol. 29, no. 3, 2013, pp. 200-205.

[7] M. Huan, "Factors affecting the bid/ no bid decision making process of small to medium size contractors in Auckland," Undergraduate Research Report-Bachelor of Construction, Unitec Institute of Technology, 2011.

[8] A. Enshassi, S. Mohamed, and A. El Karriri, "Factors affecting the bid/no bid decision in the palestinian construction industry," *Journal of Financial Management of Property and Construction*, vol. 15, no. 2, 2010, pp.118-142.

[9] A. S. Bageis and C. Fortune, "Factors affecting the bid/no bid decision in the Saudi Arabian construction contractors," *Construction Management and Economics*, vol. 27, no. 1, 2009, pp. 53-71.

[10] M. Egemen and A. Mohamed, "A framework for contractors to reach strategically correct bid/no bid and mark-up size decisions," *Building and Environment*, vol. 42, no. 3, 2007, pp. 1373-1385.

[11] A. S. Bagies and C. Fortune, "Bid/ no-bid decision modelling for construction projects," in *Proc. 22nd Annual ARCOM Conference, Birmingham, UK*, Association of Researchers in Construction Management, 4-6 September 2006, pp. 511-521.

[12] A. Hassanein and Z. Hakam, "A bidding decision index for construction contractors," *Building Research and Information*, vol. 24, no.4, 1996, pp. 237-244.

[13] B. L. Oo, H. Lo, and B. T. Lim, "The effect of bidding success in construction bidding," *Engineering, Construction and Architectural Management*, vol. 19, no. 1, 2012, pp. 25-39.

[14] T. Bedford, "Analysis of the low-bid award system in public sector construction procurement," M.S. thesis, Graduate Department of Civil Engineering, University of Toronto, 2009.

[15] M. T. Banki, B. Esmaeeli, and M. Ravanshadnia, "The assessment of bidding strategy of Iranian construction firm," *International Journal of Management Science and Engineering Management*, vol. 4, no. 2, 2008, pp. 153-160.

[16] P. G. Carr, Investigation of bid price competition measured through prebid project estimates, actual bid prices, and number of bidders," *Journal of Construction Engineering and Management, ASCE*, vol. 131, no. 11, pp. 1165-1172, 2005.

[17] J. Seydel and D. Olson, "Multicriteria Support for Construction Bidding," *Mathematical and Computer Modelling*, Elsevier, vol. 34, pp. 677-702, 2001.

[18] M. A. Azman, "Number of bidders in small and medium public construction procurement in Malaysia," *Applied Mechanics and Materials, Trans Tech Publications*, vol. 567, pp. 595-600, 2014.

[19] R. Sammoura and A. Elsayed, "Stocastic-simulation model for lowest bid price evaluation: A case study in road construction and rehabilitation projects in Lebanon," in *Proc. the First International Conference on Construction in Developing Countries (ICCIDC–I):* "*Advancing and Integrating Construction Education, Research & Practice*," August 4-5, 2008, Karachi, Pakistan, pp. 168-176.

[20] H. Hong and M. Shum, "Increasing competition and the winner's curse: evidence from procurement," *Review of Economic Studies*, vol. 69, no. 4, 2002, pp. 871-898.

[21] H. S. Jayasena, "Bid-price variability in the Sri-Lankan construction industry," M.S. thesis, Department of Building, National University of Singapore, 2005.

[22] T. Akiyama, J. Iwamatsu, and K. Endo, "Bidding strategies in Japanese construction projects," in *Proc. the 10th Symposium Construction Innovation and Global Competitiveness*, CRC Press, 2002, pp. 982-999.

[23] M. Skitmore, "The distribution of construction project bids," in *Proc. the 4th International Symposium on Building Economics*, The International Council for Building Research, Studies and Documentation, CIB W-55, Danish Building Research Institute- SBI Copenhagen Denmark, 1987, pp. 171-183.

[24] M. Skitmore, D. S. Drew, and S. Ngai, "Bid-spread," *Journal of Construction Engineering Management, ASCE*, vol. 127, no. 2, 2001, pp. 149-153.

[25] K. G. Runeson, "Analysis of building price estimates," M.S. thesis, School of Building, University of New South Wales, 1987.

[26] W. Park and W. Chapin, *Construction Bidding: Strategic Pricing for Profit*, 2nd edition, John Wiley and Sons, 1992.

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