CITC GLOBAL
Construction in the 21st Century
11th International Conference (CITC-11)
September9-11, 2019, London, UK

Springer
SPRINGER NATURE

Characteristics of Bidding for Engineering Services in Public Construction Projects

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Abstract. Engineering services to construction projects are essential to the proper delivery of construction projects. Engineering services includes both design services before construction and engineering supervision during the construction phase of the projects. Procurement of engineering services for public construction projects are performed through competitive bidding. Several scholars investigated the bidding characteristics of contractors while few or no research has addressed the bidding characteristics for engineering services. This paper presents an analysis of bidding results of 450 invitations to bid for engineering services. The analysis revealed considerable differences in bidding between design bids and construction monitoring bids. Also considerable differences in bidding characteristics exist between construction sectors that include: buildings, transportation, water and sanitary projects, and infrastructure projects. The performed analysis and the results obtained is expected to contribute to better understanding of bidding behavior of engineering consultants for engineering services and the suitability of the competitive procurement approach to this kind of projects. Construction planners can evaluate these characteristics and consider other procurement approaches for projects that involved wide disparity in the received bids in competitive bidding. Selecting proper procurement approach is expected to contribute to enhanced delivery of construction projects.

Keywords: Competitive bidding, Engineering Design, Construction Monitoring, Engineering Supervision, Engineering Supervision.

1 Introduction

Engineering services during both the design of construction projects and during the construction phase of projects (i.e. construction monitoring services) are vital services that have huge impact on the success of construction projects. Despite such importance, procurement of engineering services received little attention in the literature compared with procurement of construction services. A review of literature reveals that a number of publications have addressed design services however few or no research effort has tackled engineering services during construction phase of projects (i.e. construction monitoring services).

Several publications addressed design fee in construction projects [1-6]. Hyari et al. [1] presented a conceptual cost estimating model for engineering services in public

construction projects. The model was developed as a neural network model based on data from public construction projects in Jordan, and estimates the cost of engineering services as a percentage of the estimated construction cost. Shrestha and Mani [2] investigated the impact of design cost on the implementation of design-bid-build projects, and concluded that higher design costs are linked with better construction performance in both time and cost (i.e. construction duration and cost overruns). Feldmann et al. [7] investigated the attributes that affect the costs of engineering services procured for construction and rehabilitation projects within higher education facilities. The study utilized multiple regression analysis to study the relationships. Carr and Beyor [3] studied the design fee schedules utilized by public construction agencies as indicators in design fee negotiations, and recommended that design fee schedules should be updated regularly to match rate of increase in construction costs. Carr and Beyor [3] considered that fair compensation for design services require adjustment of design fee schedules with time.

Ling [4] investigated the determination of design fees in design-build projects. Ling indicated the existence of conflicting perspectives in determining theses fess. Designers want higher fees to improve profitability and reduce risks. On the other hand contractors look for lower design fees to improve their competitiveness. Ling [4] noticed that owners support higher fees for design services to improve quality because design costs represent a very small portion in the overall cost of the project. Hoxley [5] discussed the suitability of using competitive tendering for engineering services. The study was based on correlating the owner's perception of the quality of services received and the professional fees paid. The study concluded that competitive bidding for engineering and consultancy services does not affect the quality of the received professional services. Bubshait et al. [6] investigated the impact of design fee on design quality, and concluded that a decrease in design fee is generally associated with an increase in design deficiency.

Several publications addressed the bidding characteristics in public construction projects [8-12]. On the other hand, the review of literature indicates the lack of studies that focus on the bidding characteristics of engineering consultants while competing for engineering design and construction monitoring contracts. This paper presents an analysis of the bidding characteristics for engineering services in public construction projects. The following sections will present the bidding characteristics analyzed followed by the results of analyzing the bidding results of 450 projects that includes 4018 bids received from engineering consultants.

2 Bidding Characteristics

The analyzed bidding characteristics in this paper are: 1) number of bidders; 2) bid spread; and 3) bidding variability (coefficient of variation). The following paragraphs provide a brief description of those characteristics.

1. Number of bidders: Construction industry is characterized as highly competitive industry because generally a number of contractors compete to win the contract, knowing that only one bidder will win the competition while

the remaining bidders will lose the competition. The same applies to engineering services, and therefore the number of bidders represents an indication of the level of competition in the project. Higher number of bidders puts an additional pressure on the bidders to reduce the submitted bid to increase the chance of winning the contract because each bidder wants to be the lowest bidder [13, 14]. Different types of projects experience varying levels of competition as traditional projects normally experience higher competition than specialized projects and this should be reflected in the number of bidders in both cases.

2. Bid spread: Bid spread in construction bidding refers to the difference between the lowest bidder and the second lowest bidder is an important measure in competitive bidding. This difference is commonly named “Money left on the table” as it represents a foregone profit to the lowest bidder. Skimore et. al [11] analyzed bid spread in competitive bidding and tried to correlate it with several variables that might have an impact on the spread including: contract size value and number of bidders. Skitmore et. al. [11] concluded that analysis provide an overwhelming evidence that supports the dominance of inherent variability in bidding. Runeson [15] 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.
3. Bidding Variability (coefficient of variation): Coefficient of variation measures the variability of bidding results. Engineering consultants are equally informed since they all get the same bidding documents, and they all supposed to do accurate cost estimating before submitting their bids since they have experience in this field.. Therefore this measure can represent either the bidders' willingness to reduce bid price to win the project or the accuracy of cost estimating and the consultants' evaluation of the work required and the risks associated with the needed work [13]. This measure can be defined as the ratio of the standard deviation to the mean of received bids [16]. Higher values means higher variability in submitted results

3 Results

The performed analysis is divided to four subsections that include: (1) descriptive analysis of the data utilized; (2) bid spread; (3) coefficient of variation; and (4) number of bidders.

a) Descriptive analysis: The data includes the bid results of 450 tender announced by the Government Tenders Directorate in Jordan.The data includes 283 tenders for providing engineering supervision during the construction phase of the projects, and includes 167 tenders for design services. Figure 1 illustrates the number of projects according to the construction sector. The highest number of projects were in the buikding sector and includes 166 tenders for engineering supervision , and 106 tenders for design of buildings.

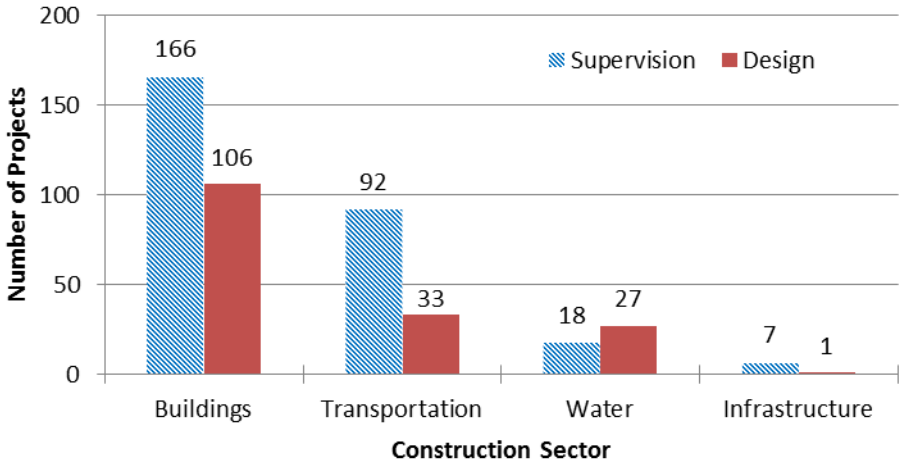

Fig.1.Number of Projects in Each Construction Sector

b) Bid spread:The difference between the lowest bid received aqnd the second lowest bid is important as it indicates the level of competition to win the bid and the quality of scope definition in the bidding documents prepared by the owner. Analysis of the bid results revealed a big difference in average bid spread between design bids and construction monitoring bids. Average bid spread was 23.7% for design bids, while average bid spread for engineering supervision bids was 8.3%. Figure 1 illustrates the average bid spread for engineering services according to the construction sector of the project. The results illustrates a big difference between design and engineering supervision bids for projects in the building sector. The highest average bid spread was for design bids for buildings (26.6%), while engineering supervision bids for buildings have an average bid spread of 8.1%. The results suggest that competitive bidding is not the best approach to procure design services for buildings. The results also indicate that design bids, in general, show higher bid spread compared to engineering supervision bids which indicates that scope of work for engineering supervision is well defined and cost can be accurately estimated in the bidding phase of the project.

c) Coefficient of variation:Consultants'firms competing for engineering services' contracts are all experienced firms with proper qualifications that qualify them to bid for public construction projects. All firms bidding for a certain project are equally informed since they get the same bidding documents, however received bids include varying bid amounts submitted by bidders. Such variability in bids is important as it reflects accuracy of cost estimating and different perceptions of bidders in the evaluation of the risks envisioned in the project. Analysis of the data revealed also a wide difference in the average coefficient of variation between ndesign bids and engineering supervision bids .The average coefficient of variation was 33.3% for design bids while the

average coefficient of variation for supervision bids was 16.3%.Figure 2 illustrates the average coefficient of variation for engineering services according to the construction sector of the project. Design bids in the building sector showed the highest bid variability with an average coefficient of variation of 38.3%, while construction monitoring bids for transportation projects showed the lowest bid variability with an average coefficient of variation of 13.2%. The widest difference between design bids and supervision bids exists in the building sector (38.3% vs. 17.9%). This again suggests that competitive bidding for design services in the buildings sector might not be the best approach. Direct negotiations or best value procurement must be investigated as an alternative approached for buuldings design services.

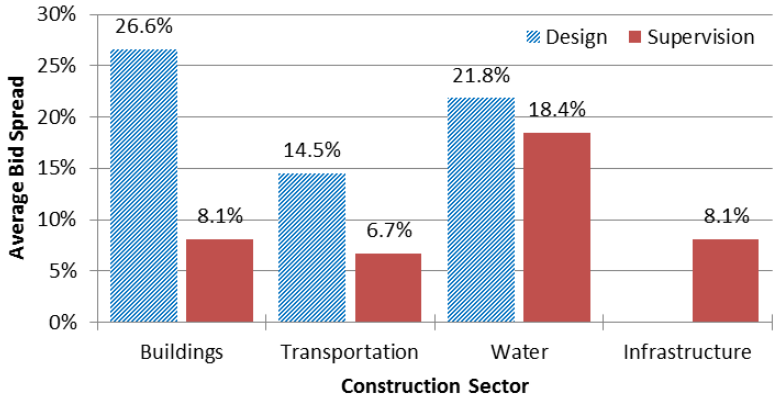

Fig.2. Average Bid Spread for Engineering Services

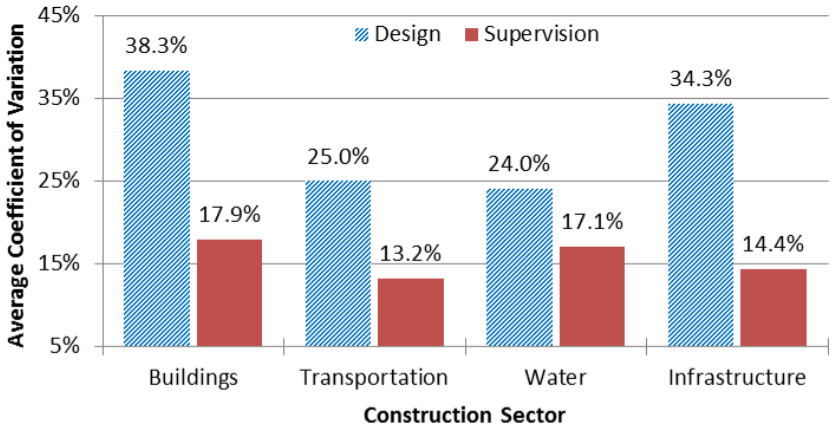

Fig.3. Average Coefficient of Variation for Engineering Services

d) Number of bidders:Construction industry is highly competitive industry and a number of contractors compete to win one contract. The same applies to engineering services. The data was analyzed to study the number of bidders competing for projects in each construction sector. As illustrated in Figure 4, the highest average number of bidders exists in the building sector in both design and engineering supervision with average number of bidders of 11.4 for building supervision projects, and an average of 9.7 for building design projects. This result reflects the high competition in the building sector. The design of transportation projects had the lowest average number of bidders (4.6) which reflects a decreased level of competition in this kind of projects that require higher engineering specialities but at the same time fewer number of projects which limits providing design services in this category to big engineering firms.

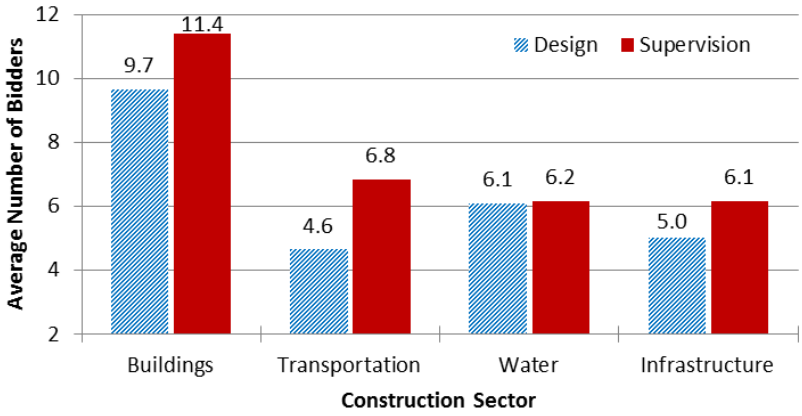

Fig.4. Average Number of Bidders for Engineering Services

4 Conclusions

This paper presented an analysis of the bidding characteristics in engineering services bids for design and/or construction monitoring of public construction projects. The data used included 4018 bids submitted by engineering consultants on 450 bidding invitations. The analyzed data revealed considerable differences in the bidding characteristics between design bids and engineering supervision bids. Submitted bids for design of buildings had the highest bid variability and the highest bid spread among design bids for other construction sectors. Also design bids had the highest average number of bidders compared to other sectors. Submitted bids for engineering supervision of buildings during construction also had the highest bid variability, highest bid spread, and highest average number of bidders. The results suggest that competitive bidding might not be the best approach for procuremet of design services for building.

194 The results presented should prove to be useful to owners and construction planners in
195 planning procurement of engineering services for construction projects.

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