Procurement of construction services: a case study on bidding competition in Singapore public sector contracts

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Abstract. There are many variables that public clients need to consider in their bidding procedure to enhance efficiency in their procurement for construction services. This paper focusses on the competitive bidding process for public sector procurement of construction services in Singapore. A distinctive feature of the Singapore government competitive bidding process is that full bidding feedback information is released to all competing bidders (and public). The specific objectives are: (i) to examine the degree of competition in the construction markets; and (ii) to examine the bidding performance of competing bidders. Based on a collection of bidding data for a 15-month period, the results show the market environment of the Singapore public sector construction contracting is highly competitive with long bidder lists. In selection of contractors, only 50% of the contracts were awarded to lowest bidders. The results also show that the competing contractors can be broadly classified into three groups based on their bidding performance in terms of number of bidding attempts, bidding success rate and bidding competitiveness. These results provide a useful insight into the bidding competition in the Singapore public sector construction contracting, especially to new market entrants and foreign contractors who want to bid for jobs in Singapore.

1. Introduction
A construction procurement design determines the overall framework and structure of responsibilities and authorities for participants within the construction processes, thus contributing to overall clients’ satisfaction and project success [1]. It involves the formulation of construction procurement strategy that requires consideration of [2]:
(i) the choice of project delivery method (e.g., traditional, design and build or project management method of project delivery);
(ii) the choice of a contract price (e.g., fixed-price or cost-plus contract);
(iii) how the contractor should be selected (e.g., tendering or negotiation);
(iv) the choice of conditions of contract; and
(v) the allocation of risks to the parties through the contract documents.
Although there may be a tendency for clients to adopt a procurement strategy that worked well for them in the past, there are many factors affecting their procurement decisions. These factors can be classified into the owners’ characteristics, the project characteristics, and the external environment [3]. The multi-attribute decision making nature have led to the researchers’ attempts to identify the selection criteria of construction procurement method and develop procurement decision-making tools and techniques to facilitate clients’ decision (e.g., [4-7]).
While the procurement decision-making process is complex that requires consideration of dependencies among various elements of a procurement design, the selection of contractor to provide...
the construction services is one of the key processes for project success that have drawn significant attention of researchers. Competitive bidding continues to be the common method of job allocations to prospective contractors, which is often in the form of descending first price sealed-bid auctions (i.e., the lowest bidder wins at the lowest bid price). Researchers have, however, urged the need for construction clients to consider multiple contractor selection criteria in their bid evaluation apart from bid price [8-10]. This can partly be explained by the fact that the construction industry has witnessed the failure of many construction businesses due to varying reasons [11,12]. Apart from the determination of bid evaluation criteria, there are many variables that clients need to consider in their bidding procedure to enhance efficiency in their procurement for construction services. These include: (i) the choice of open or selective bidding procedure; (ii) how the bidders should be grouped; and (iii) the type of information to be revealed to prospective bidders. For public sector clients, these elements are often well-structured, clearly defined and can be easily obtained from government agencies’ websites. However, these elements do vary between clients. For example, on the type of information to be revealed to prospective bidders, the information release in construction sealed-bid auctions can be broadly classified into two categories, namely public information and feedback information [13]. The common public information provided to bidders prior to bidding include project drawings and other related tender documents for bid preparation. Less common public information include the identity of competing bidders and the client’s pre-tender cost estimate. For post-auction, again, the clients can opt for different levels of bidding feedback information. This paper focuses on the competitive bidding process for public sector procurement of construction services in Singapore. A distinctive feature of the Singapore government competitive bidding process is that full bidding feedback information, i.e., the identities and bids of all competing bidders, is released to all competing bidders (and public) after tender closing date via the Singapore Government Electronic Business (GeBIZ) website (www.gebiz.gov.sg). In addition, the name of winning bidders and the awarded contract sum are all posted on the website. Focusing on public sector general building and civil engineering contracts, the specific objectives of this study are: (i) to examine the degree of competition in the markets; and (ii) to examine the contractors’ bidding performance in competing for public sector work. To the authors’ knowledge, the type of full information feedback condition in the Singapore government procurement of construction services is hardly practiced by government agencies. This case study would provide a useful insight into the bidding competition in Singapore public sector construction contracting, especially to new market entrants and foreign contractors who want to bid for jobs in Singapore.

2. The public sector procurement of construction services in Singapore

Singapore is a party to the Agreement on Government Procurement (GPA) under the World Trade Organization (WTO). The WTO GPA aims to ensure fair, transparent and non-discriminatory conditions of competition for purchases of goods, services and construction services by the public entities covered by the Agreement [14]. Under this agreement, Singapore public sector or Government Procurement (GP) of construction services with estimated contract sum of Special Drawing Right (SDR) 5,000,000 and above are subjected to the GPA provision [14]. The SDR/$ exchange rates can be obtained in the International Monetary Fund’s website and all Singapore GPs of above S$ 70,000 will follow the tendering procedures that are subjected to the GPA provision [15]. The Singapore Ministry of Finance is responsible for the GP policy framework, which governs how government agencies conduct their procurement within the GP framework. The GP framework is based on the principles of fairness, transparency and value-for-money [15].

In general, the bulk GP of construction services in Singapore are decentralized to individual ministries, departments and statutory boards that make their own arrangements. However, they must adhere to central guidelines issued by the Singapore Ministry of Finance. The Singapore Building Construction Authority (BCA) maintain a centralized registry system of suppliers for construction services, i.e., the BCA Contractors Registration System (www.bca.gov.sg/eBACS). Contractors are required to register on this system in order to bid for the public sector construction projects in Singapore. In addition, contractors in Singapore are also required to sign up as a GeBIZ Trading Partner in order to
bid for public sector work, as most of the Singapore GPs are now transacted electronically via GeBIZ portal, including publication of tender and qualification notices, electronic submission of bid offers and announcement on tender results and awards. There are three types of competitive tendering procedures in Singapore as outlined below [15]:

(i) Open tendering: tender notices are posted openly on the GeBIZ website and any BCA-registered contractors or suppliers are invited to bid based on the requirements specified in tender notices (e.g., minimum grade based on BCA Contractors Registration System).

(ii) Selective tendering: is used for more complicated purchases with sophisticated requirements that follow a two-stage procedure, i.e. short-listing of bidders via an open pre-qualification exercise and only the short-listed bidders are then invited to bid.

(iii) Limited tendering: used when the project concerns national security, or when it is not feasible or practical to call for open tenders, for example, because of intellectual property rights or for works of art. Such tenders are by invitation only, and may be open to one or a few suppliers. However, as a default, the Singapore GP agencies call open tenders to ensure transparency and fair competition, as well as to derive the best public value through open competition [15]. In the BCA Contractors Registration System, under construction workhead, contractors are grouped into two main categories, namely: General Building (CW01) and Civil Engineering (CW02). For each category, registered contractors are further grouped into seven grades with tendering limits set for each individual grade (in brackets): A1 (unlimited), A2 ($85mil), B1($40mil), B2 ($13mil), C1($4mil), C2 ($1.3mil), and C3 ($0.65mil) based on an organization’s financial capacity, track record, personnel, management and development. As of September 2017, there are 1888 and 1002 registered contractors in CW01 and CW02, respectively.

3. Competing for construction contracts in Singapore

The construction industry structure in Singapore shares the dominant structural characteristics of typical construction industry wherein: (i) there are large number of small firms and comparatively few large companies in the industry; and (ii) competitive subcontracting is well-established and used extensively in project delivery. Among the BCA-registered contractors, only about 5% of the contractors are of unlimited tendering limit with 92 and 53 A1 contractors in CW01 and CW02 categories, respectively. Multi-layer subcontracting practice, on the other hand, is common in the industry [16]. Dulaimi and Hong [16] found that many of their survey respondents of large and medium-sized Singapore contractors subcontracted 50% or more of their work.

In terms of the nature of construction demand, the construction activities in Singapore can be classified in a traditional way into two major groupings, namely ‘public’ or ‘private’ sector work as a reflection of the ownership or source of funding. Most of the projects are of residential, non-residential (building) and civil engineering work nature. In 2016, each client group contributed approximately 50% to the total construction demand in Singapore [17]. With open tendering as the default procedure for all GPs, the bidder lists for public sector work in Singapore are often long and drawn from any registered contractors who responded to tender notices, in which the lowest confirming bids dominating the awarding of contracts [18]. Dulaimi and Hong [16] found that most of the large and medium-sized Singapore contractors responded to their survey obtained 75-100% of their jobs through competitive bidding. Oo [19] found that the number of bidders per project ranges from 6 to 31 (mean = 15.72 bidders) based on 46 public sector building projects in Singapore for the period of 2002 to 2004. With the large number of bidders, contractors will have to bid for more jobs in attempts to achieve their targeted turnovers. It could also be expected that the contractors’ profit margin is low based on the argument that the local clients tend to focus on lowest bid price through extensive use of competitive bidding involving too many bidders, and thus forcing narrow profit margin in the industry [20]. There are certainly a large number of firms in the Singapore construction industry in view of the city states’ small physical size. The large number of bidders received for a project and the low level of profit, tend to support the supposition that the local construction markets are highly competitive, especially for public sector work with full bidding feedback information condition. The ‘openness’ of Singapore GP of construction
services in terms of public information available to bidders is reflected on the BCA and Hui’s [21] assertion that Singapore is one of the most open construction industries in the world.

4. Research method
This case study adopted a quantitative research approach. This approach is needed to explore the issues of interest in depth by analyzing the respective bidding data using statistical techniques. Past tender reports for all tenders closed and awarded between May 2016 and July 2017 were collected between July and Sep 2017 from the GeBiZ website and entered into a spreadsheet for data analysis. It should be noted that tenders closed within this 15-month period with no contract awarded (i.e., with a status of pending award, cancelled, or no award) have been excluded in the data analysis due to unavailability of awarded contract sum. All bid values and awarded contract sum were updated to a common base (i.e., June 2017) using the BCA [17]’s tender price index. Also, each individual bidder was assigned a four-digit code, starting with 1001, to ensure anonymity. In examining the degree of competition in the markets (objective 1), the analysis considered three measures, namely: (i) whether the winning contractor was the lowest bidder; (ii) the number of bids received; and (iii) the competitiveness of bids. For contractors’ bidding performance (objective 2), the measures that were considered are: (i) number of bidding attempts; (ii) bidding success rate; and (iii) contractors’ bidding competitiveness. The measure of competitiveness of bids was to express each bid as a percentage above the awarded contract sum (or winning bid), i.e.,

\[ BCP = \frac{100(x - wb)}{wb} \] (1)

where BCP is a bid competitiveness percentage, \( x \) is the contractor’s bid and \( wb \) is the awarded contract sum for a contract. Lower BCP indicate greater competitiveness and vice versa, with minimum and maximum competitiveness being constrained between infinity and zero, respectively. An average competitive index was calculated based on a series of bids from each individual contractor, where consistency in bidding can be gauged from the resultant standard deviation.

5. Results and discussion
The data sample contains 196 projects awarded over the 15-month period. Table 1 shows the project characteristics in terms of nature of work and project size. The project size is based on the awarded contract sum of each project. Of these, there are 149 and 39 general building (CW01) and civil engineering (CW02) projects, respectively. Also, there are eight projects that involved a combination of general building and civil engineering work (CW01&CW02). The general building work is the largest group in terms of number of projects and awarded contract sum. The corresponding total awarded contract sum is around 4,100 million, which equals to 84% of total volume of construction work for the examined period. The average project size of 27.8 million contract sum for a contract. Lower BCP indicate greater competitiveness and vice versa, with minimum and maximum competitiveness being constrained between infinity and zero, respectively. An average competitive index was calculated based on a series of bids from each individual contractor, where consistency in bidding can be gauged from the resultant standard deviation.

5.1 Degree of competition
The results show that only 98 (50%) projects were awarded to the lowest bidders. For the remaining 98 projects, there are cases where the winning contractors were the second or third lowest bidders, and that post-tender negotiation took place as demonstrated by the final awarded contract sum. It should be noted that when contractors’ bids (\( x \)) are lower than winning bids (\( wb \)), i.e., \( x < wb \), the respective BCPs are negative (Eq. 1). These negative BCPs were considered as outliers, i.e., low and non-conforming bids or suicidal bids that are below the winning bids, in the analysis. The other group of outliers are positive BCPs that are greater than 25%, a rule of thumb to identify non-serious bids that are 25% above the winning bids [22]. To provide an overview of the impact of the two groups of outliers, Table 2 shows the number of bids and average BCP before and after the removal of outliers. Before the removal of outliers, there are a total of 2874 bids received from the 196 tenders, with the average number of bidders
ranging from 13 to 15.13 for the three project types. The average BCPs are all too high (i.e., about 60 to 110% above the winning bids), and do not provide a real picture on competitiveness of contractors’ bids. Upon the removal of outliers, these respective statistics have reduced dramatically. For example, in general building group, only 33% (n = 957) of the bids are considered as competitive (or serious) bids with an average of 6.42 bidders per project and a mean BCP of 10.55%. The proportions of competitive bids for the other two project types are also around 30%, but with lower average number of bidders per project (i.e., 4.25 to 4.69 bidders). This lower intensity of competition may partly explain the respective mean BCPS that are higher than general building type.

Table 1. Project characteristics according to nature of work and project size.

| Project type                                | Number of projects according to nature of work | Average contract sum ($S mil) | Total sum of contracts ($S mil) |
|---------------------------------------------|-----------------------------------------------|-------------------------------|---------------------------------|
| General building (CW01)                      | 62 New construction 82 Renovation/Additions and Alterations 5 Maintenance | 27.80                         | 4,142.20                       |
| Civil engineering (CW02)                     | 30                                            | 18.50                         | 721.50                         |
| General building and civil engineering (CW01&CW02) | 5                                             | 9.40                          | 75.20                          |
| Overall                                      | 97                                            | 27.80                         | 4,938.90                       |

Table 2. Number of bids and average BCP before and after the removal of outliers.

| Project type                                | Number of projects | Number of bids received | Average number of bidders per project | Average BCP (%) | Std. dev. |
|---------------------------------------------|--------------------|-------------------------|---------------------------------------|-----------------|-----------|
| Before removal of outliers                  | General building (CW01) | 149                      | 2254                                  | 15.13           | 113.93    | 2774.00   |
|                                             | Civil engineering (CW02) | 39                       | 516                                   | 13.23           | 55.86     | 65.14     |
|                                             | General building and civil engineering (CW01&CW02) | 8                         | 104                                   | 13.00           | 58.32     | 132.81    |
| After removal of outliers                   | General building (CW01) | 149                      | 957                                   | 6.42            | 10.55     | 7.76      |
|                                             | Civil engineering (CW02) | 39                       | 183                                   | 4.69            | 11.70     | 8.35      |
|                                             | General building and civil engineering (CW01&CW02) | 8                         | 34                                    | 4.25            | 12.67     | 8.75      |

5.2 Contractors’ bidding performance
The 2874 bids received for the 196 projects were from 649 contractors, coded as Bidders 1001 to 1649. In examining the number of bidding attempts of each contractor, they can be grouped into three groups as shown in Figure 1. There is only a very small group of contractors (5%) who submitted more than 15 bids over the 15-month period (i.e., one bidding attempt per month on average). The next group (25%) is those submitted 5 to 14 bids, and followed by the largest group of 456 contractors (70%) with less than 5 bidding attempts for the examined period. Out of the 649 contractors, only 149 contractors had managed to win job(s). Figure 2 shows the classification of contractors according to number of winning bids. Similarly, only a very small group of contractors (5%) won more than two projects. Most of them (79%) only managed to win one single project for their bidding attempts.
Table 3 shows the bidding success rates and BCPs of ten contractors with highest number of bidding attempts recorded. The number of bidding attempts range from 21 to 78. For bidder 1543 with the highest number of bidding attempts of 78, its bidding success rate was the lowest (3.85%) among the five contractors (out of ten) who managed to win jobs. Bidder 1102 has the highest bidding success rate of 17.24% among the group. Considering the proportions of serious bids, six bidders have recorded proportions that are below the overall 30% recorded for the three project types and four of them were not successful in winning a job. With the exception of Bidder 1433, Bidders 1366, 1102 and 1625 with greater than 30% serious bids had managed to win jobs. Next, the average BCP for the ten contractors are between 7.83 and 14.01%, with large variation in bids as reflected in the standard deviation. It appears there is no clear trend indicating that the bidding success rates are related to the average BCP values, given that the mean BCPs for three most successful bidders in winning jobs (1366, 1102 and 1625) are quite high and varied (ranging from 8.17 to 12.14%). In general, these ten contractors appear to be less selective in their bidding attempts with considerably high number of bidding attempts. These bidding attempts involved submitting highly variable and uncompetitive bids and the resultant bidding success rates are considerably low (or zero).

Table 3. Bidding performance of the ten contractors with highest number of bidding attempts.

| Bidder ID | Number of bidding attempts | Number of winning bids | Bidding success rate (%) | Number of serious bids (%) (excluding outliers) | Mean BCP (excluding outliers) | Std. dev. |
|-----------|-----------------------------|------------------------|--------------------------|-----------------------------------------------|-------------------------------|-----------|
| 1543      | 78                          | 3                      | 3.85                     | 18 (23%)                                      | 13.42                         | 8.36      |
| 1546      | 47                          | 0                      | 0                        | 10 (21%)                                      | 13.10                         | 7.52      |
| 1129      | 35                          | 0                      | 0                        | 7 (20%)                                       | 8.23                          | 5.27      |
| 1366      | 32                          | 4                      | 12.50                    | 15 (47%)                                      | 11.78                         | 9.12      |
| 1433      | 32                          | 0                      | 0                        | 16 (50%)                                      | 13.74                         | 7.30      |
| 1102      | 29                          | 5                      | 17.24                    | 22 (76%)                                      | 8.17                          | 7.14      |
| 1295      | 29                          | 2                      | 6.90                     | 5 (17%)                                       | 8.16                          | 9.87      |
| 1195      | 25                          | 0                      | 0                        | 5 (20%)                                       | 14.01                         | 9.80      |
| 1625      | 25                          | 2                      | 8.00                     | 8 (32%)                                       | 12.14                         | 9.49      |
| 1503      | 21                          | 0                      | 0                        | 4 (19%)                                       | 7.83                          | 5.81      |

Next, the focus is on the bidding performance of the top 5% contractors who had managed to win more than two projects. There are eight contractors in this group, with the number of winning bids range from three to six, as listed in Table 4. Of these, three of them appears in both Tables 3 and 4, i.e., Bidders 1102, 1366, and 1543 (highlighted in grey). The other five bidders who were successful in winning jobs had considerably low number of bidding attempts, ranging from 6 to 18 bidding attempts for the 15-month period. This suggests that they were very selective in their decision to bid. Except for Bidders...
1366 and 1543, all bidders have recorded: (i) two-digit rate of bidding success close to or above 20% (between 17.24 and 50%); (ii) high proportions of serious bids that are above 50% (between 55 and 83%); and (iii) average BCP below 10%. The three lowest (most competitive) average BCPs were recorded from Bidders 1127 (1.58%), 1032 (5.37%), and 1326 (5.51%), with Bidder 1032 as the top performer with six winning bids. These results suggest that the existence of a small group of contractors who were very selective in their decision to bid, and that their bids were very competitive and resulting in high bidding success rates.

### Table 4. Bidding performance of contractors with more than two winning bids.

| Bidder ID | Number of bidding attempts | Number of winning bids | Bidding success rate (%) | Number of serious bids (%) (excluding outliers) | Mean BCP (excluding outliers) | Std. dev. |
|-----------|----------------------------|------------------------|--------------------------|-----------------------------------------------|-------------------------------|-----------|
| 1032      | 18                         | 6                      | 33.33                    | 13 (72%)                                      | 5.37                          | 6.68      |
| 1102      | 29                         | 5                      | 17.24                    | 22 (76%)                                      | 8.17                          | 7.14      |
| 1127      | 14                         | 4                      | 28.57                    | 11 (79%)                                      | 1.58                          | 2.35      |
| 1366      | 32                         | 4                      | 12.50                    | 15 (47%)                                      | 11.78                         | 9.12      |
| 1314      | 11                         | 3                      | 27.27                    | 6 (55%)                                       | 6.76                          | 9.71      |
| 1326      | 6                          | 3                      | 50.00                    | 5 (83%)                                       | 5.51                          | 8.94      |
| 1498      | 16                         | 3                      | 18.75                    | 9 (56%)                                       | 9.05                          | 7.25      |
| 1543      | 78                         | 3                      | 3.85                     | 18 (23%)                                      | 13.42                         | 8.36      |

### 5.3 Discussion

The results show that the market environment of the Singapore public sector construction services contracting is highly competitive. The bidder lists are often long and hitherto there is little change if one to compare the average number of bidders of 15.72 per project recorded in 2002 to 2004 [19] with 14.66 bidders in this case study with bidding data from 2016 to 2017. However, it is encouraging to found that 50% of the projects were not awarded to the lowest bidders. This provides evidence on the selection of contractors apart from bid price, which has been strongly advocated in previous studies. The results also show the presence of high number of outliers (about 70%), i.e., a common characteristic of construction contract bidding dataset [22]. In terms of competitiveness of bids, the contractors’ bids were on average around 10 to 12% above the winning bids upon removal of outliers. These rather high percentages suggest that the contractors’ bids were not really competitive in general, which can be partly explained by the high variability in the bids as demonstrated by the respective standard deviation.

Based on the individual contractor’s number of bidding attempts, bidding success rate and bidding competitiveness, the 649 contractors can be broadly classified into three groups. First, there is a small group of bidders (5% of 649) who were less selective in their bidding attempts. A considerably high number of bidding attempts were recorded for this group of contractors (25% of 2874 bids). Their bidding attempts involved submitting highly variable and uncompetitive bids, and the resultant bidding success rates are considerably low (or zero). The considerably low bidding success rate is not uncommon in a highly competitive market environment as such. Next, there is a very small group of contractors (1% of 649) were very selective in their decision to bid, and that their bids were very competitive and resulting in high bidding success rates close to or above 20%. The bidding success rates of this group are comparable with that of Ling and Liu [23]. In their opinion survey, they found that the average bidding success rate of 25 Singapore contractors of issued capital exceeding US$ 1 million was 38%, and 16 of them with success rates above 20%. The bids from this group of contractors were on average less than 10% above the winning bids. Lastly, the rest of the contractors who do not belong to the above two groups can be classified as the third group of contractors, forming the largest group. This classification of contractors based on the bidding performance provide a different insight on the
contractors’ bidding behavioural patterns, which is not reflected in the BCA Contractors Registration System.

6. Conclusion

Based on a collection of bidding data on Singapore public sector procurement of construction services, this case study examined the degree of competition in the general building and civil engineering construction markets, and the bidding performance of competing bidders. The results show that the market environment of Singapore public sector construction services contracting is highly competitive with long bidder lists. In selection of contractors, only 50% of the contracts were awarded to lowest bidders, providing evidence on the selection of contractors apart from bid price. The results also show that the competing contractors can be broadly classified into three groups based on their bidding performance in terms of number of bidding attempts, bidding success rate and bidding competitiveness. These results provide a useful insight into the bidding competition in Singapore public sector construction contracting, especially to new market entrants and foreign contractors who want to bid for jobs in Singapore. Using the same dataset, further work is planned to investigate the effect of various project characteristics on contractors’ bidding performance, and to explore how the contractors were selected if they were not the lowest bidders.

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