Key Attributes Underpinning Different Markup Decision between Public and Private Projects: A China Study

ABSTRACT

In the construction industry, contractors have to improve the efficiency of markup decision-making to survive from fierce business competition. The effect of client type on markup decision has been aware in previous studies and contractors are advocated to take account of decision factors properly when they are confronted with different types of projects. Nevertheless, the rationales behind the inclusion of different factors in markup decision-making for different projects sustain unknown. In this study, fifty-three factors were identified after extensive literature review and interviews with professionals. The identified factors were afterwards grouped under the headings of nine attributes and compiled in a questionnaire for survey in China. Using the Hotelling's T-square test, it is found that three attributes (i.e., project characteristic, client characteristic, and macro condition) can explain the effect of client type on contractors' markup decision. The research findings provide useful insights into the cognition of bid pricing as well as the improvement of bidding efficiency. While the research works were situated in China, contractors in other countries could benefit from the research findings in a similar vein.

KEYWORDS

Bidding, markup decision, decision factors, competitiveness, China

1. INTRODUCTION

Previous studies have shown that managerial decision-making usually lasts several minutes and only ten percent of the decision-making activities exceeds one hour's duration (Mintzberg, 1971). The

short period of time given to decision-making spells out the prominent role of both intuition and experience in business management. Managerial decision is in nature triggered from individuals' sentiment, psychology and emotion, and it can be made in a dissimilar way subject to personal divergence. Hence, both the extent to which managerial decision adheres to cognition and the discrepancy between cognition and decision-making deserve much attention in the discipline of management science.

This is the case in the construction industry. In this industry, competitive bidding has gained burgeoning popularity of awarding construction contracts (Christodoulou, 2010). The main tenet of construction bid decision is to price contracts competitively to strike the trade-off between competitiveness (i.e., pricing as lowly as possible) and profitability (i.e., pricing as highly as possible) (Chapman et al., 2000; Dawood, 1995). Bid pricing is a complicated and time-consuming process of decision-making, as there are many determinants related to project characteristic and economic situation that cannot be interpreted easily (Chua et al., 2001). The complexity of pricing activities necessitates a proper cognition of bidding business. Along this strand of thoughts, a large volume of literature has addressed the subject of construction bidding from the perspectives of contract type (Drew and Skitmore, 1997), industrial experience (Fu et al., 2003), competitiveness (Lu et al., 2008), bid/no bid decision (Bageis and Fortune, 2009; Egemen and Mohamed, 2007), and markup decision (Christodoulou, 2010). Nonetheless, contractors in practice appear to make bid decision subjectively, and intuition derived from a mixture of gut feelings, experience and guesses seems to precede quantitative approaches (Ahmad, 1990; Chua et al., 2001; Lowe and Parvar, 2004). Therefore, whilst the subject of construction bidding has been explored at full length, the discrepancy between cognition and decision-making can still be found in the sphere of construction business competition.

Recent years have witnessed academic disputes over the factor of client type in relation to construction bidding. On one hand, it has been emphasized that client type is a typical markup decision factor (Akintoye, 2000; Fayek, 1998; Ling and Liu, 2005; Phillips et al., 2008). This factor,

55 in the view of Flanagan and Norman (1982b), has a major impact on contractors' bidding behaviours.
56 As echoed by Bageis and Fortune (2009), client type (public/private) ranks third in the minds of
57 contractors when they are making decision on markup size. In accordance with these prior studies,
58 different types of clients may have different requirements and expectation, and contractors have to
59 manage construction projects differently (Egemen and Mohamed, 2006). On the other hand, a
60 negligible role of this factor has been reported in some other studies in the same vein. Watt *et al.*
61 (2009) asserted a slight difference between public and private clients in the categories used to select
62 suppliers. Wong *et al.* (2000) claimed that clients, whatever public or private, may adopt equivalent
63 approaches to measure the competitiveness of contractors. Furthermore, the prevalence of
64 public-private partnerships (PPP) in construction project procurement reflects that both public and
65 private clients are manageable to achieve common project goals. Behind PPP-based projects are
66 business agreements between a public entity and a private partner to secure the financing,
67 construction, and operation of a public infrastructure (Regan et al., 2011). To summarize, the
68 ongoing disputes over the effect of client type on bid decision signify that the questions whether and
69 why markup decision-making should be handled differently between public and private projects
70 remain inexplicit.
71
72 The aim of this study is therefore to investigate the rationales behind contractors' markup decision
73 for different types of clients. Data for analysis were gathered from the Chinese construction industry.
74 The study is expected to assist both clients and contractors in improving the cognition of bidding,
75 thus bid decision can be made in due ways. It is vitally important that clients, whoever public or
76 private, can receive value for money through the smooth running of a competitive tendering
77 mechanism (Drew and Skitmore, 1992). In reverse, business failures might arise when "the identity
78 of client" has not received much attention (Odusote and Fellows, 1992). The remainder of the paper
79 is organized into eight sections. Section II and Section III present relevant theories on contractors'
80 markup decision. Section IV introduces competitive bidding practices in China. Research
81 methodology and data analysis are described respectively in Sections V and VI. Findings and

discussion are addressed in Section VII. The last section concludes the research.

2. KEY FACTORS AFFECTING MARKUP DECISION

The shift of contractor selection philosophy from "lowest-price wins" to "multi-criteria selection" has appealed to contractors to innovate business paradigm in a timely fashion. In the lowest price approach, value for money is difficult to secure (Holt et al., 1995), as the overemphasis on construction cost is unbeneficial to the attainment of combined project goals (e.g., schedule, quality, environment, and social responsibility) (Lo et al., 2007). In the multi-criteria approach, the bottom line of tendering is to determine most competitive contractors to satisfy the multi-dimensional demands of clients. Clients' diverse demands are formed in some specific industrial environments, which according to Newcombe (1990), have two layers of determinants in common. One refers to general environment factors such as politics, law, economics, sociology and technology; and the other is competitive environment factors including finance, plant, labour, management, suppliers, subcontractors, consultants, and clients. There is no doubt that different types of clients may place emphasis on different environmental factors, and contractors' bidding behaviours should be adjusted accordingly.

Pricing bids efficiently favours contractors to outperform competitors and to make a profit (Egemen and Mohamed, 2006; Oo et al., 2008b). In practice, contractors first estimate the possible cost of resource elements including labour, equipment and materials, and then give a marginal rate to formulate a bid price (Shash, 1993). Within a limited timeframe for bidding, contractors are inclined to choose those projects on which they have the strength of pricing (Oo et al., 2008b). The empirical study by Aibinu and Pasco (2008) have demonstrated that the estimates of smaller projects are more subject to bias than those of larger projects, and the pre-tender building costs are more often overestimated than underestimated. Such estimate difference is attributable to the effect of bid pricing factors. As disclosed by Elhag *et al.* (2005), in addition to the experienced-based nature of

pre-tender cost estimation, the key factors determining cost estimation include client characteristic; consultant and design parameters; contractor heterogeneity; project characteristic; contract procedures; procurement methods; and market condition. Nevertheless, the main challenges in bid pricing arise from the determination of markup size (Dawood, 1995). Drew and Skitmore (1992) stated that markup decision should take account of contingency, while subsequent studies (e.g., Christodoulou, 2010; Shash, 1993) have complemented with two factors - office overhead and profit. Through an extensive literature review, a larger amount of markup decision factors are given in Table 1. Given the complexity of markup decision factors as shown in Table 1, a proper understanding of markup is a prerequisite to successful bid pricings.

<<Insert Table 1 here>>

3. EFFECT OF CLIENT TYPE ON MARKUP DECISION

Clients' roles in construction competition

Constructing a project involves a hybrid process comprising the components of both products and services (Maloney, 2002). In this process, clients are the demanders of products/services, while construction firms stand on the other side to supply the products/services (Myers, 2004). Clients set the scene for contractors to compete against each other and kick off the competition for contracting out construction works. First, clients observe, interpret and translate end-users' need, expectation and desire into specifications of construction products/services. Second, they lay down investment intention and produce drawings specifying the form, components and size of prospective projects. Third, they formulate tender documents; invite contractors to bid; and screen out qualified main contractors. Lastly, clients will select subcontractors, management contractors, materials suppliers, specialists, and labour contractors after main contractors are determined.

Lowest price is a traditional approach that has been broadly used to measure contractor competitiveness. In this approach, clients often invite too many contractors to tender for pre-defined contracts, which will intensify business competition at the project level as a consequence (Flanagan and Norman, 1985; Fu et al., 2003). Intense business competition in turn renders clients stronger bargaining power than before (Egemen and Mohamed, 2006). The probability of winning construction competition depends on the extent to which contractors meet clients' requirements and expectation with reasonable prices. Therefore, the role of clients in construction business competition is devising a game rule for a pool of contractors to compete and running the game as a referee. Such role implies that contractors' bidding behaviours is embedded in a proper cognition of clients' requirements and expectation, and it is essential that contractors are able to maintain good interactive relationships with clients through organizational and individual learning (Fu et al., 2003).

Public and private clients

Client type is multi-faceted in the discipline of institutional economics. It could refer to the status quo of resource ownership, task allocation, governance structure, and investor relationship. The categories of clients in construction range widely from a government agency, a local authority, to an industry or a property owner in the form of legal entity or natural person. A prevalent approach in the domain of construction management and economics is to divide clients into two categories - public and private. Pubic clients are governments or public authorities that rely on public budgets to sponsor a spray of projects, such as urban infrastructures, municipal buildings, and public residential housings, for the welfare of greater communities. A private client is an individual/ organization who enlists the services of a construction company for commercial interests. Private projects come in all different shapes and sizes, including commercial residential buildings, commercial facilities (e.g., building restaurants, grocery stores, shopping centers, sports facilities, hospitals, private schools and universities), and industrial projects (e.g., power plants, manufacturing plants and refineries).

Previous studies have been aware of the difference between public and private clients in the domain of construction project management. Holt *et al.* (1995) revealed that public clients acquire less costly projects but suffer time overrun, while private clients complete project construction on time with more flexible methods but the management costs more money. The study by Bageis and Fortune (2009) found that public clients are less likely to default on payment, suggesting that in contrast to private clients, public project managers might be less worried about project financing. In addition, Shen and Song (1998) asserted that quality and credibility are major preferences of public clients in the Chinese competitive tendering mechanism. Furthermore, there are a couple of studies as listed in Table 2 that delineate different tendering rules between public and private sectors. The different tendering rules indicate that public and private clients differ from each other in many aspects, such as project financing, corporate governance, and resource utilization, and the difference necessitates distinguishing decision-making on markup size between the two types of projects.

<<Insert Table 2 here>>

4. CONSTRUCTION BIDDING PRACTICES IN CHINA

China has implemented a tendering system since the turn of the last century (Wang et al., 1998). The implementation of tendering system has advanced the old planned economy to a socialist market one (Shen and Song, 1998). It has been shown that the tendering mechanism facilitates the improvement of construction investment efficiency and the internationalisation of construction business (Wang et al., 1998). The competitive tendering approach has to date gained extensive application and has been very popular nationwide (Liu et al., 2007). The conventional governmental-free allocation of China has been replaced with more flexible financings such as commercial loans from banks. As a result, numerous private projects emerge all over the country. By far, private construction sectors, such as collective-owned firms, private investment firms, and joint ventures have become important ingredients of the whole construction industry (Shen et al., 2004).

China's tendering system is characterised by its unique social, cultural and economic background (Wang et al., 1998). The tremendous economic growth in China has yielded huge demand for infrastructure projects which are usually commissioned and funded by public sector clients (Walker et al., 1998). In accordance with China's Tender Law enacted in 1999, public works shall all be contracted out through a competitive tendering approach (Shen et al., 2004), but this arrangement is optional to private sectors. The fierce business competition for either public or private projects in China brings to the fore contractor competitiveness. In light of the characteristics of China's business environment, Shen *et al.* (2004) identified some key parameters including management skill, technical ability, financing ability, organization structure, marketing ability, social influence and contribution to project objectives for the assessment of contractor competitiveness. Based on these parameters, Lu *et al.* (2008) revealed that contractor competitiveness in China is concerned with project management skills, organization structure, resources, competitive strategy, relationships, bidding, marketing, and technology. These two studies concur with the findings by Shen *et al.* (2006) that contractor competitiveness is partly determined by project type.

5. METHODOLOGY

The quantitative approach was adopted as the research methodology for this study. Four main steps were taken accordingly. First, a set of preliminary markup decision factors were derived by using the techniques of literature review and interview. Second, the identified factors were grouped for the formulation of questionnaire. Third, a questionnaire survey was thereafter conducted to collect empirical data. Last, the collected data were analysed to detect the importance levels of the identified factors.

Identifying preliminary factors

A thorough literature review was conducted to identify those factors that have potential impacts on contractors' markup decision. A tentative list of sixty-five factors was derived at first. As these factors were identified from leading international journals and not all of them are suitable to China's construction industry, five senior professionals from Chongqing, Shenzhen, Shanghai, Zhejiang, and Beijing were invited to make comments and suggestions on the tentative factors. These respondents were interviewed just because they have much knowledge of construction business nationwide. Their comments help remove those obviously unsuitable factors and add some factors that are of merits to the study. Feedbacks of the professionals were well compared by the research team. If three or more professionals agreed highly on an item, it would then be removed or added accordingly. As a result, fifty-three factors were documented in Table 3.

<<Insert Table 3 here>>

The factors listed in Table 3 were grouped in light of the attributes of clients they reflect. To collect quality feedbacks, workshops, of which the participants include academicians, professionals, and local government officer, were conducted to cluster the factors into nine groups (Table 4).

<<Insert Table 4 here>>

The nine attributes are described as follows based on their relevance to bidding business as indicated by the workshop participants.

(a) Project characteristic - the fundamental project features in terms of size, type (e.g. infrastructure, private residential buildings), and construction complexity.

(b) Tendering procedure - qualification of tenderers, tendering activities, and tendering rules.

(c) Contract requirement – key issues that clients require contractors to promise in the subsequent contracts.

(d) Construction plan - the supports and preliminary arrangements of onsite construction activities.

(e) Client characteristic - the features of clients in terms of track record, reputation, capability, and competitiveness.

(f) Potential competitors - potential tenderers who are to submit tenders for the same contract work.

(g) Procurement – project procurement with respect to procedure, cost, and procurement environments.

(h) Contractor heterogeneity - the state of competitive advantages of being heterogeneous.

(i) Macro condition - market situation, industrial status, economic prosperity, relevant regulations and policies.

Data collection

Evaluating relative importance is a useful approach to identify key factors from a number of alternatives. The Likert scale is usually used to facilitate the evaluation of relative importance through collating respondents' opinions. In this study, fifty-three factors (Table 3) were compiled in a questionnaire for survey. The questionnaire form contains two sections. The first section introduces the objectives and scope of the survey. This section is also used to collect demographic data regarding the respondents' education background, professional areas, years of work, position, and company names. The other section serves for respondents' opinions on the importance level per factor. In this section, all factors are tabulated with two columns (public and private), and respondents are reminded to answer each factor on both columns. Otherwise, the completed questionnaire will be considered invalid. A five-point Likert scale (5-extremely important, 4-important, 3-neutral, 2-umimportant, 1-extremely unimportant) was adopted to collect respondents' answers.

The works by Lu *et al.* (2008) identified a number of critical success factors for the competitiveness of contractors in China. In view of the similarity, the sampling configuration and the survey procedure by Lu *et al.* (2008) were followed in this study. For simplicity, the details of survey process are not repeated in this paper. Overall, a postal survey of 500 randomly selected contractors were undertaken and 133 questionnaires returned in a usable format, giving a response rate of 26.6%. Of the returned questionnaires, three were abandoned as the responses are incomplete or the respondents indicate that they have limited knowledge of either public or private construction business. The demographics of the respondents are given in Table 5. While it is quite difficult, if not impossible, to measure the extent to which the participated respondents represent the whole construction industry, their diverse backgrounds and work experiences hopefully prevent bias and prejudice in the study.

<<Insert Table 5 here>>

Hotelling's T-square test

In order to test the difference of the nine attributes, which are composed of a number of factors, between public and private projects, the Hotelling's T-squared (HT2) test was considered. The distribution of HT2 is a generalization of Student's *t* distribution that can be used to assess the statistical significance of the difference between two sample means. HT2 test applies to multivariate statistics in undertaking the tests of differences between multivariate means of different samples. There are some versions of HT2 test, such as one sample *t*-test, paired *t*-test, and two sample *t*-test. In viewing the structure of the collected questionnaire data, multivariate paired HT2 test was conducted in this study. The null hypothesis of the multivariate paired HT2 test in the study is that given a factor classified under an attribute, it has an indifferent importance level between public and private projects.

6. DATA ANALYSIS

Data conversion

Respondents' judgments on each factor were grouped into paired samples - Group 1 for public clients and Group 2 for private clients. The returned questionnaires were classified into twenty-one groups according to the provincial construction sectors that respondents indicate. Mean values per factor per group were derived with reference to the following equations to make sure that the derived mean values can follow a continuous distribution on the range (1, 5).

$X_{ijk} = \frac{\sum_{j=1}^{n} x_{ij}}{n}$, and $\overline{X_j} = (x_{1j} + x_{2j})/2$

Where *i* refers to 1 and 2, representing public and private projects respectively; X_{ij} refers to the importance score given by respondents to factor *j* for project *i*; X_{ijk} refers to the importance level of attribute *k* for project *i;* $\overline{X_j}$ refers to the mean value of importance of factor *j*.

The importance coefficients listed in Table 6 show that the nine attributes have effect on the determination of contractors' different markup decision, as their mean values are all larger than 3 (neutrally important).

<<Insert Table 6 here>>

Data validation

The converted data were examined for validation prior to the HT2's test.

(1) Testing normal distributions for each factor. The above data conversion leads to the development of nine matrixes which comprise a number of factors. Each factor has twenty-one mean values and the values were used to test whether the mean values obey the requirements of normal distribution. The test is based on Kolmogorov-Smirnov (K-S) coefficients. It was found that all K-S coefficients for Group $X_{1j} + X_{2j}$, Group X_{1j}, and Group X_{2j} have Pr- values larger than 0.05, indicating that both Group X_{1j} and Group X_{2j} can satisfy the normal distribution.

(2) Testing variances between Group X_{1j} and Group X_{2j}. The structured mean values were analysed to test whether the factors have significantly indifferent variances. The derived P values for a vast majority of factors are all larger than 5%. This suggests that the factors have significantly indifferent variances, and the collected data be used to conduct HT2 test.

Results

Recall that the test is intended to identify whether the attributes differ from each other in contributing to markup decision between public and private projects. According to the principle of HT2 test, if both Wilks'λ and Hotelling's trace P value for an attribute are smaller than 5%, the null hypothesis can be rejected. The rejection of the null hypothesis means that the paired samples are distinguishable in terms of the relevant attribute. Results of Hotelling's T-square test include the values of intra-group P, indicating the variability of the factors under an attribute with regard to their possible causes. Results of the HT2 test are listed in Table 7.

<<Insert Table 7 here>>

As given in the table, the values of Wilks'λ and Hotelling's trace range from 0.000 to 0. 602; the largest values of intra-group P, ranging from 0.181 to0.967, are underlined in the left column to

highlight the most possible reason for the corresponding attribute. Results of the data analysis show that both Wilks'λ and Hotelling's trace P for three attributes (i.e. project characteristic, client characteristic, and macro condition) are less than 0.05, suggesting that their null hypotheses can all be rejected. This means that these three attributes can be used to explain why markup decision factors should differ when contractors are bidding for different types of projects (public or private). In reverse, six attributes, namely contract requirements, construction plan, procurement, contractor heterogeneity, potential competitors, and tendering procedure have larger values of both Wilks'λ and Hotelling's trace than 0.05, suggesting that their null hypotheses cannot be rejected. This implies that some markup decision factors can be treated similarly in tendering for either public or private projects.

7. FINDINGS AND DISCUSSION

Different markup decision factors

The results of data analysis show that three attributes can differentiate the markup decision-making on one type of projects from that on the other type of projects. These attributes will be discussed as follows with respect to their importance and implications to bidding practices.

Project characteristic

The significance of this attribute to bid decision has been pinpointed in previous studies (Dulaimi and Hong, 2002; Egemen and Mohamed, 2007). As pointed out by Flanagan and Norman (1982a), bid decision is in part determined by construction managerial complexity. The larger the project size, the higher the construction managerial complexity. This is probably the reason why contractors usually determine marginal scale in line with project sizes (Fayek, 1998). Dulaimi and Hong (2002) pointed out that project characteristic is a major category of common factors that researchers often

cite to explore the theme of construction bidding. While this research agrees with previous studies on the importance of project characteristic to bid decision, it is found that the different characteristics between public and private projects deserve much attention in the determination of markup size. As shown in Table 5, the significance of this attribute is mainly devoted by the type of project works (SF-1). In effect, public project works are technically complicated than private project works (Chiang et al., 2001), and contractor competitiveness is changeable with project types (Shen et al., 2006). Therefore, contractors are recommended to make due response to different projects' competition to reach a high level of competitiveness.

Client characteristic

Another key attribute underpinning contractors' different markup decision between public and private projects is client characteristic. This attribute presents the status quo of clients from many perspectives including company size, organizational structure and reputation. As discussed in Section 3, different clients have their own ways in selecting business partners, though they might be under certain market condition (Egemen and Mohamed, 2006). For instance, Phillips et al. (2008) disclosed that clients' concerns precede other aspects used to differentiate bids in the UK social housing sector. Hence, it is very important that contractors can respond to clients' requirements and expectation appropriately. In this sense, experienced contractors are able to own more competitiveness than inexperienced contractors in bidding (Fu et al., 2003). The primary reason is that experienced contractors usually have a better perception of the characteristics of clients, and they know how to manage inherent project risks effectively. The importance of this attribute is mainly contributed by the factor of clients' unreasonable requirements (SF-25). As shown in Table 2, the intention of private clients in constructing projects is for the pursuit of profits. They may impose some unreasonable requirements onto contractors such as delay in payment, longer time of guaranty of quality, and tighter schedule to reap a certain level of profits. Therefore, it is implied that contractors should be able to evaluate unreasonable requirements of clients and improve the

404 efficiency in the compilation of bid prices.

405

406 ***Macro condition***

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408 Contractors' success in a given market environment is to acquire a set of environmental rules of
409 thumb that enable them to prevent pitfalls in bid decision-making process (Oo et al., 2008b).
410 Previous studies have suggested that economic and political conditions be included to achieve a
411 rigorous markup size decision (Dulaimi and Hong, 2002; Egemen and Mohamed, 2007; Fayek,
412 1998). In effect, macro condition is multifaceted and composed of politics, law, economics,
413 sociology, and technology (Newcombe, 1990). Doubled by some factors such as local industrial
414 situation, current workload, and future available works in the market, macro condition has been
415 recognized as a principal external determinant of bidding behaviours (Drew and Skitmore, 1997;
416 Flanagan and Norman, 1982a). As indicated in Table 7, the importance of this attribute is
417 underscored by the factor of SF-52 (social demand of the project types). Comparing contractor
418 competitiveness between Hong Kong and Singapore, Oo *et al*. (2008b) pinpointed that Hong Kong
419 contractors are more influenced by market condition in the markup decision-making phase. Such
420 difference can be ascribed to the fact that Hong Kong contractors can maintain a long-term
421 coordinated interaction with local market (Kim and Reinschmidt, 2006).

422

423 **Common markup decision factors**

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425 There are six common attributes behind markup decision factors for both public and private projects,
426 indicating that they can be handled similarly as discussed below.

427

428 ***Contract requirements***

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430 Contract requirements are essential to compile tenders and can be a key determinant of bid pricing

(Lowe and Parvar, 2004). The study by Drew and Skitmore (1997) found that different bidders prefer to different characteristics of contracts (e.g., size and type) and different degrees of selectivity in contracts to derive an optimal markup size. However, it is found that project type, whatever public or private, makes no sense to the selectivity. The main reason is two-faceted, namely unreasonable contractual clauses (SF-14) and construction schedule requirement (SF-15). Shash and Abdul-Hadi (1992) revealed that the size of contract together with the availability of required cash and labour are often stressed in making markup decision in Saudi Arabia. A highly standardized contract facilitates contractors to follow clients' demand and to price bids in due course (Fu et al., 2003).

Construction plan

A construction plan describes contractors' pre-arrangement to undertake prospective construction activities with the focus on construction methods, quality and safety, site layout, occupational measure, construction plant and equipments, labor allocation, and project team (Zou, 2007). Detailed instruction will be offered in a construction plan for contractors to estimate construction cost. Contractors' responsiveness to a construction plan mirrors the competitiveness of contractors. The main contributor of this attribute is the readability of planning and design drawings (SF-20). Dyer and Kagel (1996) pointed out that two aspects of knowledge should be acquired from past contracting experience, namely requirements of workmanship standards and attitudes to accepting alternative construction methods of the same client, and cost information of similar projects. As discussed above, public clients are accountable to local society, while private clients are usually apt for high construction quality of projects. However, in light of this attribute, it is found that contractors can adopt a similar approach to examine construction plans for both public and private projects when making markup decision.

Procurement

458 Efficient management of subcontractors and suppliers convinces tenderers to mitigate the uncertainty
459 of procurement at an early stage. Therefore, procurement determines the efficiency of markup
460 decision (Fayek, 1998). Construction labor, major construction materials and equipment, and social
461 relationship cost are grouped under this attribute. These sub-items accord with the status quo of the
462 Chinese construction industry. For instance, China's construction firms have been confronted with the
463 shortage of manpower and a sharp increase in labor cost (Lu et al., 2013). Market supply of labor
464 (SF-37) is the major contributor to this attribute. The identification of the factor (SF-37) echoes
465 previous studies on that tenderers apt at entering lower bids have much more possibility of owning a
466 certain level of competitiveness (Drew and Skitmore, 1997; Fayek, 1998), and can extend the findings
467 of Elhag *et al.* (2005) which attach the importance of construction cost only to the pre-tender stage.
468
469 ***Contractor heterogeneity***
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471 Contractor heterogeneity means firms' capability or resources that are unobservable by their
472 competitors. This attribute aligns with the critical success factors for the competitiveness of Chinese
473 contractors (Lu et al., 2008), and can supplement the work by Shen and Song (1998) that outline it
474 simply in the selective tendering and negotiation approaches. There exists in nature heterogeneity
475 across contractors in terms of their (i) intrinsic bid/no-bid preferences, and (ii) responses to decision
476 to bid factors (Oo et al., 2007). Dulaimi and Hong (2002) grouped several factors determining
477 markup size decision, such as contractor characteristics. Furthermore, Oo *et al.* (2008a) pointed out
478 that there is heterogeneity in the population of contractors, and individual contractors exhibit
479 different bidding behaviours when encountering a given set of bidding variables. Oo *et al.* (2010)
480 found that contractors' bid decisions are dependent on many unobserved individual firm-specific
481 heterogeneity. The unobserved heterogeneity in the opinions of Gonzalez-Diaz *et al.* (2000) includes
482 the capability of manager, the quality of output and competitive strategy. However, findings of this
483 study show that competitive strategy of the contractor (SF-42) is a key determinant of contractors'
484 heterogeneity and it plays parallel role in the determination of markup decision.

485

486 ***Potential competitors***

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488 This attribute describes the population, actions and competitiveness of potential competitors.
489 Potential entrants are a key variable of Porter's (1980) five forces model. According to this model,
490 the competition for a construction work contract encompasses the existing competition among
491 established firms and the potential competition imposed by new entrants. Previous studies have
492 investigated these two parts of competition and found that potential competitors are more able to
493 dominate the trend of project competition (Ye et al., 2008). A high level of profitability pulls
494 potential entrants to pack into the project competition, giving rise to fiercer business competition and
495 lower tender prices as a result (Park and Chapin, 1992). With this in mind, the aspiration of
496 contractors to bid for project contracts can fade with the increase in the density of bidders (Oo et al.,
497 2008b). In this study, contractors have to face the parallel role of this attribute in the sphere of
498 markup decision for both public and private projects. The parallel role is subject to the common
499 effect of the relationships between clients and potential competitors (SF-28). Therefore, to achieve a
500 competitive bid, contractors need to have adequate knowledge of potential competitors when
501 competing for some known construction works, whatever public or private.

502

503 ***Tendering procedure***

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505 This attribute is an element of tendering environment and it has attracted close attention in the area
506 of construction bidding. Lowe and Parvar (2004) described this attribute as a key determinant of
507 bid/no-bid decision, while Dulaimi and Hong (2002) revealed that bidding situation is one of the
508 factors frequently used to examine contractors' markup decisions. The factor of project costing
509 methods (SF-5), specifying a bill of quantity based or cost quota - based approach, is usually
510 stipulated as a main content of tendering procedure in China. A recurrent bidding situation
511 characterised by standardized bidding rules or procedures stimulates contractors to develop

situation-specific learning (Fu et al., 2003). For instance, the tendering evaluation procedure in the public sector should ascertain public accountability (Alsugair, 1999; Wong et al., 2001). With this in mind, a couple of factors such as the relationships with stakeholders, innovation, and social responsibility in construction are often employed to constitute the paradigm of markup decision-making as far as possible (Langford and Male, 2001; Tan et al., 2010).

From cognition to markup decision

The above discussion has disclosed three key attributes that underpin contractors' different markup decision between public and private projects. The identification of these attributes reinforces the notion of project-based contractor competitiveness (Shen et al., 2006) and situation-specific learning (Fu et al., 2002). These three attributes are useful for contractors to reconsider markup decision-making approaches when they are involved in different types of projects. Meanwhile, there are six attributes that contractors can treat in similar ways in the determination of markup size for whatever public or private projects. The research findings revise those previous studies (e.g., Egemen and Mohamed, 2007; Watt et al., 2010) that place emphasis on key markup decision factors as shown in Table 1 without taking into account the effect of client type. The key attributes hopefully support contractors to achieve a proper perception of bid pricing, and thereby tender prices can be formulated correctly. Markup decision-making is challenging, as many uncertain and complex factors should be considered (Bageis and Fortune, 2009). Therefore, while the key attributes shed some lights on the improvement of competitiveness, contractors have a long road to walk from proper cognition to efficient markup decision.

There are some markup decision approaches such as the utility theory model by Dozzi et al. (1996), the competitive bidding strategy model by Fayek (1998), the artificial neural networks by Li et al. (1999), and the computer-based markup decision support system by Li and Love (1999). A major limitation of these models is that they only take account of significant factors that can be readily

quantified. In effect, in line with the key attributes identified in this study, these quantitative approaches are oversimplified and are unable to reflect the complexity and uncertainty of bidding situation (Egemen and Mohamed, 2008). In practice, contractors might be subject to low efficiency if the different characteristics between public and private projects are not well interpreted. A series of recent advances in computational analysis, such as matrix calculations, expert systems, ANN and fuzzy logic, have allowed for the inclusion of a couple of quantitative and qualitative factors in the development of bidding models (Christodoulou, 2010). Hence, these decision models are expected to advance to interpret the difference between public and private projects in China.

8. CONCLUSIONS

Contractors are subject to low tendering efficiency if they rely on an unchangeable set of decision factors to bid for different types of projects. The research found that project characteristic, client characteristic and macro condition can be used to explain the difference of markup decision between public and private projects. Meanwhile, there are six common factors that contractors can treat similarly in the determination of markup size for both the two types of projects. The six factors are contract requirements, construction plan, procurements, contractor heterogeneity, potential competitors and tendering procedure. Interestingly, the different markup decision factors can be appreciated at the early stage of project competition, while the common decision factors are based on construction activities. The research findings are of values for construction firms to achieve a better notion of markup decision and to improve the efficiency in markup decision. Thereby, they are able to advance the cognition of decision factors and the advanced cognition paves the way for the improvement of markup decision-making approaches in the future. As there exist sub-categories of public or private projects, findings of the research can shed lights on different markup decision within a single sector of clients. Future studies are recommended to look at the difference of markup decision between sub-categories of projects within private or public sectors.

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691 Table 1 Markup decision factors in previous studies

Reference	Data/Sample	Factor number [a]	Key Factors
(Ahmad and Minkarah 1988)	400 of the top general contractors in the United States	31 (8)	type of job, location, size of job, need for work, owner, subcontractors, degree of hazard, degree of difficulty
(Seydel and Olson 1990)	The case of a small firm (FBK builders)	5	profitability, risk reduction, continuity, capital exposure, work force continuity
(Drew and Skitmore 1992)	Quantity surveying practice in Hong Kong	3	bidder size, contract value and project type
(Herbsman and Ellis 1992)	The USA and Singapore construction industries	7	cost, time, quality, safety, durability, security, and maintenance
(Shash 1993)	300 top contractors in the UK	55	the need for work, the number of competitors, the amount of experience on such projects, the degree of difficulty, the risk involving owing to the nature of the work, the current work load
(Hatush and Skitmore 1997)	Eight construction personnel in the north west of England	20 (8)	past failures, financial status, financial stability, credit ratings, experience, ability, management personnel, management knowledge
(Fayek 1998)	A sample engineering construction contractor	93 (11)	project characteristics, design characteristics, cost estimate characteristics, project-related characteristics, project-related opportunities, company characteristics, corporate and budgetary considerations, the client, competition, characteristics of subcontractors and suppliers, economic and political conditions
(Akintoye 2000)	Eighty-four UK contractors in various firm sizes	24(7)	complexity of the project, scale and scope of construction, market conditions, method of construction, site constraints, clients' financial position, buildability and location of the project
(Chua *et al.* 1999)	153 top contractors in Singapore	28 (4)	competition, risk, need for work, and company's position in bidding
(Dulaimi and Hong 2002)	General building contractors in Singapore	40 (5)	project characteristics, project documentation, company characteristics, bidding situation, the economic environment
(Ling and Liu 2005)	Contractors in Singapore	52 (21)	payment record of client, size of client, type of client, etc.
(Egemen and Mohamed 2007)	Contractors in the Northern Cyprus and Turkish	42	firm-related factors, project-related factors, market conditions/expectations and strategic considerations
(Phillips *et al.* 2008)	Contractors in the UK social housing sector	35 (1)	understanding of clients objectives, innovative management, successful track record, innovative construction practices, quality management procedures, transparency of cost data, understanding of partnering, established policy (health & safety, environmental), understanding of best value, technical ability
(Watt *et al.* 2010)	Several international organizations and Australian construction companies	3	past performance, technical expertise, and cost

692 Note: a – number of preliminary factors (number of key factors)

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696 Table 2 Different concerns between public and private projects

Factors	Public sector contracts	Private sector contracts	References
Profitability expectation	Low	High	(Holt *et al.* 1995)
Flexibility of Tendering procedure	Strict	Loose	(Shen *et al.* 2004; Drew and Skitmore 1997)
Accountability requirements [a]	High	Low	(Drew and Skitmore 1997; Holt *et al.* 1995)
Diversity of works	More	Less	(Drew and Skitmore 1992)
Design and specification	Complicated	Simplified	(Drew and Skitmore 1992)
Bidding methods	Competitive	Selective or competitive	(Drew and Skitmore 1992; Herbsman and Ellis 1992)
Lowest-price wins	Less frequently	Frequently	(Drew and Skitmore 1992)

697 a - i.e. cost limits and specification stipulations.
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700 Table 3 Markup decision factors identified

Code	Factors	References	Code	Factors	References
SF-1	Type of public project	Fu et al., 2003	SF-28	Relationships between the client and tenders	Egemen and Mohamed, 2006
SF-2	Project size	Drew and Skitmore, 1997	SF-29	Competitiveness of potential competitors	Oo et al., 2008
SF-3	Project complexity	Flanagan and Norman, 1982	SF-30	Irregular/illegal tendering behaviours of potential competitors	Oo et al., 2008
SF-4	Tender preparation cost	Fayek, 1998	SF-31	Operation order of local construction market	Drew and Skitmore, 1992
SF-5	Project costing methods	Zou, 2007	SF-32	Strengths of the designer	Dyer and Kagel, 1996
SF-6	Availability of time for tender preparation	Oo et al., 2008	SF-33	Efficiency of the tendering agency	Wang et al., 1997
SF-7	Tendering methods (open/invited)	Zou, 2007	SF-34	Availability of major construction materials	Liu et al., 2007
SF-8	Track record of project consultants	Phillips et al., 2008	SF-35	Cost of manpower	Shash, 1993
SF-9	Tender evaluation methods	Wong et al., 2001	SF-36	Market supply of equipment and machinery	Zou, 2007
SF-10	Contract types (lump sum/unit rate)	Drew and Skitmore, 1997	SF-37	Market supply of labour	Shash, 1993
SF-11	Project financing	Han and Diekmann, 2001	SF-38	Social relationship cost	Zou, 2007
SF-12	Advance payment by contractors	Han and Diekmann, 2001	SF-39	Cooperation between the contractor and the client	Ling and Liu, 2005
SF-13	Reimbursement of auditing fees	Zou, 2007	SF-40	Partnerships between the contractor with local governments	Wang et al., 1997
SF-14	Unreasonable contractual clauses	Chan and Au, 2007	SF-41	Competitiveness of the contractor	Shen et al., 2004
SF-15	Construction schedule requirement	Watt et al., 2009	SF-42	Competitive strategy of the contractor	Shen et al., 2004
SF-16	Construction quality requirement	Zou, 2007	SF-43	Status quota of business operation (the contractor)	Drew and Skitmore, 1992
SF-17	Engineering technical requirement	Zou, 2007	SF-44	Risk management competence (the contractor)	Seydel and Olson, 1990
SF-18	Environmental protection requirement	Zou, 2007	SF-45	Cost management competence of the contractor	Fayek, 1998
SF-19	Adequacy of geotechnical engineering information	Zou, 2007	SF-46	Experiences of similar projects	Fu et al., 2003
SF-20	Readability of the planning and design drawings	Holt et al., 1995	SF-47	Current workload (the contractor)	Drew and Skitmore, 1992
SF-21	Governmental approval on public project construction	Shen et al., 2004	SF-48	Macro-economic policy	Wang et al., 1997
SF-22	Number of projects under construction (the client)	Flanagan and Norman, 1982	SF-49	Annual investment size of public projects	Drew and Skitmore, 1992
SF-23	Reputation of the client	Bageis and Fortune, 2009	SF-50	Prosperity of local economy	Flanagan and Norman, 1982
SF-24	Professionalism of the client	Bageis and Fortune, 2009	SF-51	Status quota of real estate market	Egemen and Mohamed, 2007
SF-25	Unreasonable requirements of the client	Drew and Skitmore, 1992	SF-52	Social demand of the project types	Drew and Skitmore, 1992
SF-26	Project financing sources of the client	Shen et al., 2004	SF-53	Sustainable construction policies	Zou, 2007

SF-27	Number of potential competitors	Oo et al., 2008			

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704 Table 4 Categorization of the key factors affecting markup decision

Factors	Factors
Project characteristic	SF-1, SF-2, SF-3
Tendering procedure	SF-4, SF-5, SF-6, SF-7, SF-8, SF-9
Contract requirement	SF-10, SF-11, SF-12, SF-13, SF-14, SF-15, SF-16, SF-17, SF-18
Construction plan	SF-19, SF-20, SF-21
Client characteristic	SF-22, SF-23, SF-24, SF-25, SF-26
Potential competitor	SF-27, SF-28, SF-29, SF-30
Procurement	SF-31, SF-32, SF-33, SF-34, SF-35, SF-36, SF-37, SF-38
Contractor heterogeneity	SF-39, SF-40, SF-41, SF-42, SF-43, SF-44, SF-45, SF-46, SF-47
Macro condition	SF-48, SF-49, SF-50, SF-51, SF-52, SF-53

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707 Table 5 Demographics of the respondents

Source*	Beijing 10/25	Chongqing 15/20	Fujian 5/15	Guangdong 16/28	Guizhou 3/10	Hubei 2/10	Hunan 3/14
	Jiangsu 16/30	Liaoning 9/20	Shandong 8/32	Shanghai 11/28	Sichuan 14/26	Yunan 3/8	Zhejiang 15/35
Position	Top managers 18	Departmental managers 35	Project managers 29	First-line operators 22			
Expertise	quantity surveying 48	tendering 23	construction technology 31	quantity surveying plus tendering 14	Relevant fields 5		
Work year	1-2 25	3-5 46	6-10 35	10 above 24			

708 note: (a) * - successful response / mails sent; (b) there are totally 199 questionnaires that were sent out to other 17

709 provinces, but the research team did not receive any response.

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711 Table 6 Mean values of the attributes

	Project characteristic	Tendering procedure	Contract requirements	Construction plan	Client characteristic	Potential competitors	Procurement	Contractor heterogeneity	Macro condition
Public	3.92	3.46	3.78	3.59	3.27	3.77	3.70	3.75	3.59
private	3.28	3.38	3.73	3.54	3.58	3.78	3.72	3.79	3.64

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714 Table 7 Results of the Hotelling's T-square Test

Key Factors	Factors	Wilks'λ			Hotelling's trace			Intra-group
		λ	F	P	Trace	F	P	P
Project characteristic	SF-1	0.378	28.802	0.000	1.642	28.802	0.000	0.181
	SF-2							0.000
	SF-3							0.000
Tendering procedure	SF-4	0.713	2.348	0.052	0.402	2.348	0.052	0.238
	SF-5							0.782
	SF-6							0.150
	SF-7							0.633
	SF-8							0.058
	SF-9							0.167
Contract requirements	SF-10	0.747	1.203	0.327	0.338	1.203	0.327	0.457
	SF-11							0.392
	SF-12							0.541
	SF-13							0.817
	SF-14							0.967
	SF-15							0.967
	SF-16							0.187
	SF-17							0.812
	SF-18							0.516
Construction plan	SF-19	0.923	1.056	0.379	0.083	1.056	0.379	0.186
	SF-20							0.383
	SF-21							0.288
Client characteristic	SF-22	0.687	3.282	0.015	0.456	3.282	0.015	0.001
	SF-23							0.002
	SF-24							0.115
	SF-25							0.468
	SF-26							0.214
Potential competitors	SF-27	0.925	0.749	0.565	0.081	0.749	0.565	0.440
	SF-28							0.854
	SF-29							0.800
	SF-30							0.515
Procurement	SF-31	0.816	0.929	0.565	0.225	0.929	0.565	0.823
	SF-32							0.226
	SF-33							0.633
	SF-34							0.431
	SF-35							0.453
	SF-36							0.150
	SF-37							0.842
	SF-38							0.359
Contractor heterogeneity	SF-39	0.813	0.820	0.602	0.231	0.820	0.602	0.295
	SF-40							0.666
	SF-41							0.885
	SF-42							0.950

	SF-43							0.409
	SF-44							0.842
	SF-45							0.174
	SF-46							0.453
	SF-47							0.880
Macro condition	SF-48	0.555	4.675	0.001	0.801	4.675	0.001	0.093
	SF-49							0.079
	SF-50							0.347
	SF-51							0.007
	SF-52							0.822
	SF-53							0.035