Awarding Construction Contracts on Multicriteria Basis in China

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Abstract: China's entry to the World Trade Organization (WTO) will allow both domestic and overseas construction firms to compete under the same market conditions. This development will lead to a more rigorous participation from overseas construction professionals in the Chinese construction market. Nevertheless, this participation can only be effective or successful when there is a proper understanding about the construction procurement practice in China. The Chinese construction practice has its own characteristics, such as governmental regulations, professional qualification systems, and procurement systems. These characteristics present a different practice in awarding construction contracts from that in the West. This paper investigates the characteristics of construction business environment in China and identifies the key parameters used in assessing contractors' competitiveness for awarding construction contracts in the market. The parameters are useful tools for assisting contractors in identifying their strength and weakness, thus reengineering actions can be adopted for improving competitiveness. A case study is used to demonstrate how these multiple parameters are used in the process of awarding contracts in the local market.

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Introduction

Bidding appears to be the dominant mechanism for allocating construction contracts in most market economies. In line with the shift from a planned economy to a socialist market economy in China, bidding has also become the major mechanism for allocating works to contractors in the Chinese construction market. Bidding mechanism was introduced to the Chinese construction market in the middle 1980s, and its application has developed dramatically over previous years. It has become a legal requirement to award all public sector contracts through bidding procedures since 1 January 2000, when the ''law of tendering and bidding'' was introduced (Wang and Shen 2001).

Generally, in deciding which contractor is awarded a contract, a public sector client is essentially comparing competitiveness between competing contractors. Thus improving competitiveness is a contractor's major strategy. Traditionally, tender price is mainly used for assessing contractor's competitiveness. However, research demonstrates that there is a weakness where only tender price is used for selecting contractor, such as poor quality and prolonged construction duration (Drew and Skitmore 1997; Song and Shen 1998; Cheng et al. 2000). A number of research works have been attempted to address these weaknesses by considering more factors in evaluating a contractor's competitiveness. For example, Hatush and Skitmore (1997) adopted five elements for assessing contractors' competitiveness, including financial soundness, technical ability, management capability, health and safety, and reputation. Shen et al. (1999) developed a bidding model which considers tender price and construction time collectively in measuring contractor's competitiveness. The study by Cheng et al. (2000) adopts the factors apart from tendering price of management skill, technical ability, and financial status in selecting contractors. These works emphasize that a contractor's competitiveness should be assessed not only by considering his commitments specified in the tender, such as tender price and contract time, but also by assessing his previous experience and current capacity. The commitments specified in the tender are contractor's planned contributions to project objectives, whereas previous experience and capacity present a contractor's built strength usually indicated by his management skill, technical ability, financial status and reputation. Both a contractor's built strength and its planned contributions are important, and they should be considered collectively when contractor's competitiveness is assessed.

Nevertheless, the limitation exists in using Western methods directly to the Chinese construction market for selecting contractor as these methods do not take into account the characteristics of the local market. There are many differences in undertaking construction business in China from that in the West. The study by Walker et al. (1998) suggests that the major differences of the Chinese construction market from that in the West include the changes in the move from a planned economy to a socialist market economy, the strong governmental supervision over the majority of construction companies, and the majority of the works commissioned and funded by public sector. These local characteristics present a special market environment where contractor's competitiveness is assessed in a special way. Contractors who used to do business in the West and who are not prepared for the

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government supervision will be seen differently in terms of their competitiveness. While overseas firms can be very competitive in certain areas, they can also lose competitiveness in a number of aspects in the local market. Shen et al. (2001) examined the typical risks faced by overseas partners in joint construction organizations in China, and found that poor understanding about the difference of the local business environment from their host countries weakened largely their competitiveness.

The aim of this paper is to present the major characteristics of the construction business environment in China, and determine the key parameters used for assessing contractors' competitiveness in awarding construction contracts in the Chinese construction market. The application of the parameters will be demonstrated through a case study. The work is expected to assist contractors, both domestic and overseas, in identifying their strength and weakness in this promising market, and give them the opportunity to take reengineering actions for improving their competitiveness.

Construction Business Environment in China

In line with China's entry to the World Trade Organization (WTO), the operation of the Chinese construction industry is going to be further reformed towards competitive procurement practice. Over previous years, the Chinese government has been actively promoting this practice. The efforts have led to major developments, including the change of project finance from traditionally governmental-free allocations to loans from commercial banks, and the change of project procurement from traditionally governmental assignments to marketing competition. Consequently, nonstate owned construction sectors, such as collective-owned firms, private firms, and Sino–foreign joint ventures have grown rapidly. A recent survey shows that the Chinese construction industry is changing rapidly from traditionally state-owned firms' domination to business-share among various types of organizations including collective-owned firms and foreign-participated joint ventures. Foreign-participated firms in the market have been increasing from very few in the early 1990s to over 2000 in year 2000 (Shen et al. 2001). It can be expected that the development of overseas firms in the Chinese construction market will continue with the driving force of China's entry to the WTO.

There are several studies examining the construction business environment in China. The study by Walker et al. (1998) suggests that the governmental influence to the construction market in China will continue within the frame of a socialist market economy, although such influence is changing from traditionally administrative control to legal monitoring. Raftery et al. (1998) identified the trends of the recent developments in the construction industry in several Asian countries, including China, and suggested that there was an increasing participation of foreign sector in the domestic construction market. In fact, overseas and private construction sectors have developed as an important part of construction business in China. It is suggested that China as a newly industrializing country will open its construction market further and enjoy the share of construction spending in GDP peaks for coming years (Crosthwaite 2000). While these studies demonstrate the change and development of the Chinese construction business environment, there is a lack of study in presenting a profile of the characteristics of the business environment.

In order to examine the characteristics of the construction business environment in China, it is useful to gain an understanding of the implication of construction business environment. Newcombe (1990) described the construction business environment by two groups of factors: general environment factors (including politics and law, economics, sociology, and technology) and competitive environment factors (including finance, plant, labor, management, suppliers, subcontractors, consultants, and clients). The study by Rolstadas (1995) characterizes construction business environment by global competition, marginal market, customer in focus, and environment protection restrictions. Others consider globalization or internationalization as the major characteristic of future construction business environment (Raftery et al. 1998; Crosthwaite 2000; Ofori 2000). In fact, these studies have considered three aspects in describing the characteristics of construction business environment, namely, business relationship, regulation frame and general environment. By using these three aspects, a profile of the Chinese construction business environment can be developed, as shown in Fig. 1.

In the figure, the inner layer (namely, business relationship) and the outer layer (general environment) have been well examined in the existing studies (He 1995; Shen et al. 1996; Shen and Song 1998; Walker et al. 1998; Shen et al. 2001). The discussion here focuses on the intermediate layer, namely, the regulation frame that regulates the business operation procedures, liabilities, and authorities. The Chinese government has been developing and revising various regulations in order to guide the reform of its construction industry. Thus there are numerous regulations in the current practice. Construction firms in China operate business under a very complicated regulation framework. This framework can be described with eight major regulation systems: (1) business license and qualification; (2) quality monitoring; (3) project supervision; (4) tendering; (5) professional qualification management; (6) initial capital; (7) contract administration; and (8) owner responsibility. Each system is administered by various regulations. The complexity of the regulation frame indicates the strong governmental influence on the operation of the construction market in China. The implementation of these systems induces differences in operating construction business between China and overseas, and their major characteristics are highlighted in the following subsections.

Business License and Qualification System

This regulatory system is defined in the official documents construction law [National People's Congress (NPC) 1998], regulation on construction enterprise business qualification [Ministry of Construction (MOC) 1995], and regulation on qualification management for construction enterprises (MOC 2001). According to the principles defined in these regulations, construction enterprises operate business within certain types of works in line with the specifications defined in their qualification grades. Contractors are divided into three categories, namely; main contractor, specialist contractor, and labor contractor. Main contractors are grouped into 12 categories, such as general building, road, and harbor, and classified as Special Grade (highest level) and Grades I, II, and III (III as lowest level). Specialist contractors are divided into 60 categories, such as earthwork, foundation work, finish work, and so on, and graded Grades I, II, and III. And labor contractors are divided into 13 categories such as carpentry and steel fixer, and classified as Grades I and II. The criteria for assessing the level of business qualification grade include the level of registered capital, staff capacity, technology capacity and previous track record. The grade can be lowered or upgraded through an official review. Enterprises are not allowed to lend or sell their qualification grade. Foreign construction enterprises must apply and register for a specific qualification grade.

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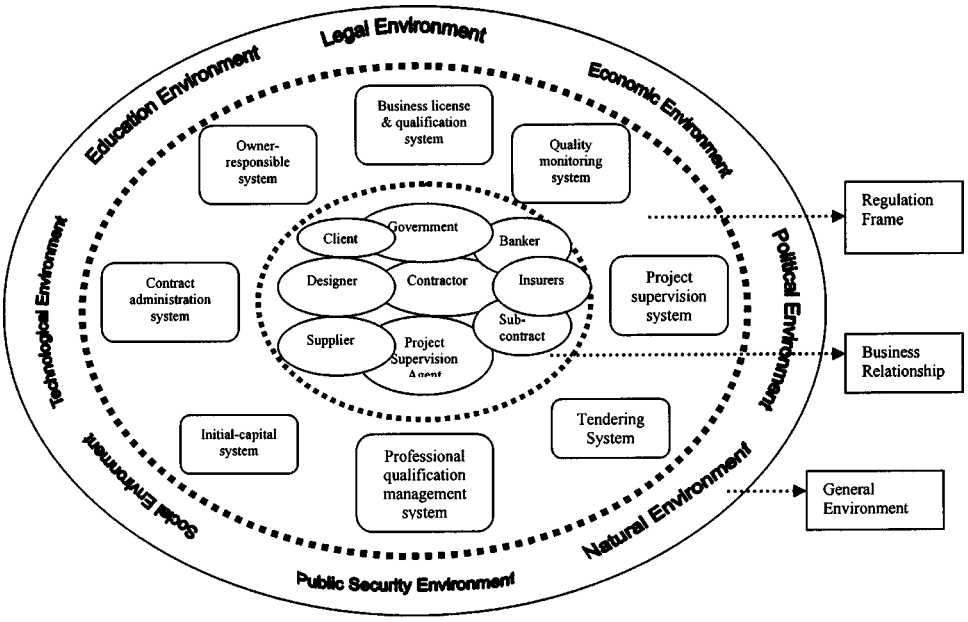

Fig. 1. Profile of construction business environment in China

Quality Monitoring System

The regulations for monitoring construction quality include the regulation on construction project quality management [State Council (SC) 2000], the regulation on protecting housing project quality (MOC 2000a), and the construction law (NPC 1998). Major terms of these regulations include: (1) construction quality must satisfy the benchmarks set by the government; (2) the quality performance grading system is used to assess contractors' performance, and quality grade can affect a firm's business qualification grade; (3) quality responsibilities are defined for all project parties; (4) the completion of a project with the client's satisfaction is confirmed with a written certificate 'PASS' which will be recorded in governmental office; and (5) the defect liability period (DLP) is applied to all projects, with the minimum DLP varying for different types of projects, for example, the DLP for structural works is 20 years (SC 2000).

Project Supervision System

Construction project supervision is a newly established mechanism in the Chinese construction industry, and supervision engineer is introduced as a profession to supervise the construction performance for the interests of the public and clients. The implementation of the system is regulated in two regulations, namely, the construction law (NPC 1998), and the regulation on project supervision (MOC 1996a). Construction projects are divided into two groups, with one adopting the supervision mechanism by compulsion and the other applying the mechanism on voluntary basis. Criteria are set by government for differentiating the two groups of projects, for example, large scale or public projects must adopt supervision procedures. The roles and responsibilities of supervision engineers are defined in the regulations, and the supervision procedures for Sino-foreign joint venture projects and foreign-alone projects are also specified.

Tendering System

The practice of tendering for construction projects is defined in three official documents: the law of bidding and tendering (NPC 2000), the construction law (NPC 1998), and the Regulation on Qualification Administration of Project Tendering Agency (MOC 2000b). The major tendering procedures are regulated, including inviting tenders submitting tenders, opening tenders, evaluating tenders, and confirming the successful tender. The criteria are regulated for forming tender evaluation panel. Projects are divided into group (a) adopting tendering procedures by compulsion and group (b) applying the procedures on voluntary basis. Criteria are set by the government for differentiating the two groups. The emphasis of tendering system is given for ensuring tendering process open, fair, and just.

Qualification Management System

Since middle 1990s, several professions have been established in the Chinese construction industry. Project supervision engineer was introduced in 1994 (MOC 1996a), project manager introduced in 1995 (MOC 1995), and project cost engineer established in 1996 (MOC 1996b). In order to develop a professional system and improve the standard of professionals' performance, regulations are made, including the Regulation on Assessment and Registration for Project Supervision Engineer (MOC 1992), and the Regulation on Assessment System for Project Costing Engineer [MOC and Ministry of Personnel (MOP) 1996]. According to the regulations, professionals must obtain professional qualifications and undertake business within the context defined in the qualification certificates, and their responsibilities, authorities, and benefits are specified. The procedures for examining, registering and monitoring the performance of individual professionals are also specified.

Initial Capital System

Delaying project completion has been a typical problem in the Chinese construction practice. The shortage of client's capital is suggested as a major reason for the problem (Hai et al. 1999). For improving the practice, the government has issued regulations requiring that sufficient capital must be secured by client before the construction of a project can start. These regulations include

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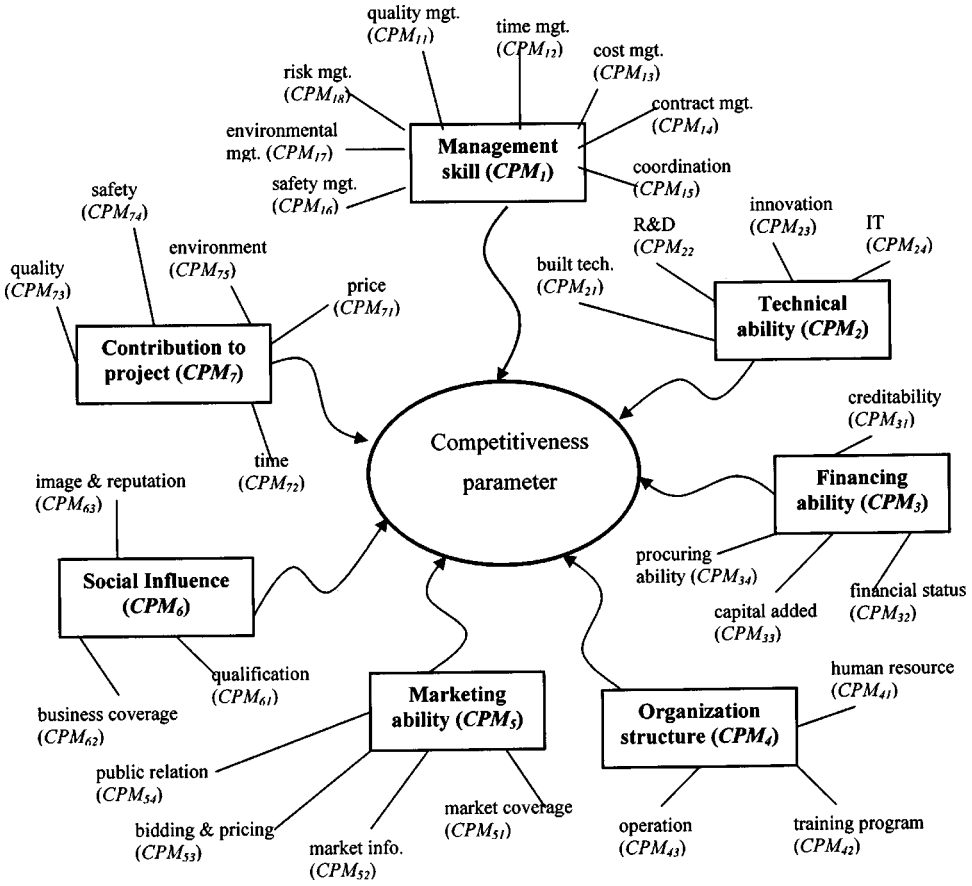

Fig. 2. Contractor competitiveness parameter model

the Regulation on Auditing the Feasibility of Capital Investment Project [National Audit Bureau and National Development and Planning Commission (NAB and NDPC) 1992], and the Regulation on Implementing the Project Initial-Capital System to the Fixed Asset Investment Project (SC 1996). In line with these regulations, the project client must make not less than a 30% contribution to the project initial capital apart from the money procured through bank loan and other credits. It is also regulated that project initial capital should be 20–35% of the total project investment, depending on the conditions and types of projects.

Contract Administration System

As construction business has been gradually guided by marketing mechanism and less influenced by administration measures in China, contract administration becomes increasingly important. Regulations have been adopted for promoting and guiding project contract administration, including the Regulation on Implementing Construction Project Contract (MOC 1993), Policy of Implementing Building Contract (sample format) [MOC and National Commerce and Administration Bureau (NCAB) 1999], the contract law [National People's Congress (NPC) 1999], and the Policy of Implementing Project Supervision Contract (sample format) (MOC and NCAB 2000). These regulations have specified the major issues in practicing contract administration, including the principles of formulating and committing building contracts, the procedures of implementing contract administration, the mechanism of contract claims, and the governmental roles in supervising and monitoring the implementation of project contract.

Owner Responsible System

It used to be unclear about who should manage the process of developing a public sector project in the China. A project owner-responsible mechanism was introduced in 1996 for specifying the public sector's responsibilities. The Regulation on Implementing Project Owner-responsible System was introduced in 1996 (NDPC 1996). The regulation requests that the legal person or owner must be identified in all public sector projects to carry on the responsibility of managing project process, including planning, financing, construction, operation, and maintenance of the project. The regulation also specifies the criteria for identifying the legal person, the terms of reference for those key managerial staff who are to run the project, and the guidelines for examining and monitoring the staff's performance.

Criteria Used in Assessing Contractor's Competitiveness in China

The discussion in the previous section demonstrates that the Chinese construction business environment is subject to a complicated set of regulations. In relation with this complexity, the criteria used in assessing contractor's competitiveness are multiple, and Fig. 2 presents a competitiveness parameter model. The model incorporates seven competitiveness attributes: management skill (CPM_1), technical ability (CPM_2), financing ability (CPM_3), organization structure (CPM_4), marketing ability (CPM_5), social influence (CPM_6), and contribution to project objectives (CPM_7). The value of each attribute is determined by

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Table 1. Measures/Criteria for Determining Value of Competitiveness Parameter

Competitiveness parameter	Measures/criteria determining the performance value of competitiveness attribute
Quality management (CPM_{11})	Availability of quality management system, effectiveness of applying quality management methods, number of quality awards or punishments, number of major quality accidents over previous 3 years, satisfaction level in providing maintenance service during DLP, return rate of retention deposits
Time management (CPM_{12})	Effectiveness of applying time controlling methods, previous records of construction delay, proportion of liquidated damage to annual works, number of time extension claims over previous 3 years and the rate of successful claims
Cost management (CPM_{13})	Effectiveness of using cost control methods, records of cost reduction to contract sum over previous 5 years, proportion of claims to contract sum over previous 3 years
Contract management (CPM_{14})	Availability of contract administration system, number and value of contract claims and the success rate of the claim over previous 3 years, rate of successfully committing contracts and the ratio of the cost for contractual dispute settlement and contract sum in past 3 years
Coordination (CPM_{15})	Effectiveness of co-ordination with subcontractors, records of major disputes between various parties in the past 3 years, ability of site management
Safety management (CPM_{16})	Availability and effectiveness of safety management staff, availability and effectiveness of safety measures on site, and effectiveness of accident settlement process
Environmental management (CPM_{17})	Availability and effectiveness of environmental management staff, availability and effectiveness of environmental protection measures
Risk management (CPM_{18})	Skill and experience of using various risk management methods
Built technology capacity (CPM_{21})	Total construction plant capacity, construction plant capacity per staff, proportion of advanced construction plant, utilization efficiency (ratio) of construction plant, and equipment depreciation rate
R&D ability (CPM_{22})	Establishment of research unit and capacity of research staff, level of investment on R&D, application rate of the new technology developed internally, and level of external dissemination of the internally developed new technology
Innovation (CPM_{23})	Number of patents owned by the organization, number of new technology or management methods in application, number of patent transfers, and status of technology advancement in comparing to other firms within the industry
IT application (CPM_{24})	Extent of information technology application, level of software development and internal application, availability of IT training to staff
Creditability (CPM_{31})	Creditability grade certificated by relevant bodies, annual value of loans obtained, level of satisfaction in communication with bankers, and knowledge about financial policy
Financial status (CPM_{32})	Assets status, profit status, and debt status
Capital added ability (CPM_{33})	Total assets growth rate, growth rate of gross output, profit growth rate, capital growth rate
Procuring ability (CPM_{34})	Proportion of the value of self-procured materials/equipment to the total consumption in the previous 3 years, market coverage for procuring resources, methods of procurement (such as e-commerce), ability of transporting goods, skill of tax clearance
Using human resource (CPM_{41})	Gross output per capita, profit per capita, rate of technical staff to total organizational staff, proportion of human resources costs to total business costs
Training program (CPM_{42})	Availability of resources and programs for training, strategies for human resources development
Organization operation (CPM_{43})	Adequacy of organization structure, adequacy of personnel recruitment procedures, mechanism of reward and benefit distribution
Market coverage (CPM_{51})	Business share at various regional levels (local, provincial, national, international), business share by industrial sectors
Market information (CPM_{52})	Availability of the system dealing with market information, ability of information processing and degree of IT application in managing the information
Bidding and pricing ability (CPM_{53})	Previous success rate in pre-qualification, previous success rate of bidding and the value of annual contract works in the past 3 years
Public relation (CPM_{54})	Level of satisfaction in communicating with project clients, government departments, subcontractors and suppliers, news medium (for business promotion), and the public.

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Table 1. (*Continued*)

Competitiveness parameter	Measures/criteria determining the performance value of competitiveness attribute
Qualification (CPM_{61})	Business qualification grade, professional qualification grade for key managerial staff within the organization
Business coverage (CPM_{62})	Business engagement at various location levels (local, provincial, national, international), business engagement in various industrial sectors (building, civil, and so on), business engagement with various specialisms (construction, design, and so on)
Image and reputation (CPM_{63})	Creditability in committing contract, rate of successfully completed contract in the past 3 years; records of safety performance, quality performance, environment & hygiene performance in the past 3 years; bank credibility grade; corporate identity
Tender price (CPM_{71})	The difference of bidder's tender price and client's benchmark price
Construction time (CPM_{72})	Client's requirements specified in the tendering document
Quality plan (CPM_{73})	Client's requirements specified in the tendering document
Safety plan (CPM_{73})	The availability and quality of safety plan
Environmental protection plan (CPM_{75})	The availability and quality of environmental protection plan

a number of parameters. For example, management skill (CMP_1) is demonstrated with the management performance in quality, time, cost, contract, co-ordination, safety, environment, and risks (Yao 1998; MOC 2001).

Similarly, other competitiveness attributes are also affected by various parameters, as shown in Fig. 2. Technology ability (CMP_2) is the driving force for building up a contractor's business competence, and is indicated by the equipped technology capacity, research & development (R&D) ability, technology innovation ability, and the application of information technology (IT) (Liu and He 2001). Financing ability (CMP_3) not only indicates the amount of money readily available but also the ability of effectively using the money, and thus the attribute is characterized with creditability grade, financial status, capital added ability, and procuring ability (MOC 2001). Organization structure (CMP_4) is adopted as competitiveness attribute because it indicates the adequacy of organizational compositions and the way of utilizing human resources. The quality of organization structure is indicated by the performance of using human resources, development programs of human resources, and the performance of organization operation (MOC 2001). The significance of effectively using human resources for improving competitiveness has been echoed in the study by Rolstadås and Andersen (2000).

Two other attributes, namely, marketing ability (CMP_5) and social influence (CMP_6), concern a contractor's promotion ability. Marketing ability is measured with multiple dimensions, including marketing coverage for business, marketing information, bidding and pricing, and public relationship (MOC 2001). Social influence is indicated by business qualification grade, qualification grade of the key managerial staff, business coverage and market share, and organization image and reputation (MOC 2001). Image and reputation are considered particularly important contributors to the value of social influence. Furthermore, the attribute ''contribution to project objectives (CMP_7)'' indicates a contractor's planned contributions to project objectives set by client. The value of this attribute is mainly measured by considering tender price, contract time, quality plan, safety plan, and environmental protection plan.

Contractor's overall competitiveness is determined by the values of these parameters built in the seven attributes. Although established benchmarks for calculating parameter values are not available, relevant regulations discussed previously in this paper provide guidelines, which are summarized in Table 1. The following section will present a case study showing the procedures of applying the competitiveness parameters in the process of awarding a construction contract in the Chinese construction market.

Application of Competitiveness Parameters Model—Case Study

Competitiveness parameters discussed in the previous section are used in different ways in the practice for assessing contractor's competitiveness when different projects are concerned. A case study is used here to demonstrate the application of several major parameters. A public hospital building project with the construction area of 35,000 m^2 in Shanghai was procured through open tendering. Interested contractors obtained project information through the local construction project transaction center (CPTC). According to the ''law of tendering and bidding'' (NPC 2000), all municipal or provincial level cities must establish a CPTC where project bidding information is available to those contractors who look for works. All public sectors are requested to provide the center the information and pay certain service charges to the center. Nonpublic sector clients can use the CPTC service on volunteer basis for advertising projects but will bear higher service charges. From CPTC, contractors can obtain the advertisements for new works, or the information about the tendering evaluation results from previous cases. The CPTC service to contractors is free of charge.

In the project mentioned here for case study, there were 30 contractors who responded to the advertisement by submitting the applications for tendering. Prequalification assessment on the contractors' competence was conducted. The client produced the guidelines and detail procedures of prequalification assessment, and obtained the approval from the Governmental Procurement Office (GPO). In fact, the formulation of the assessment guidelines and procedures is on an ad hoc basis with considering both the conditions of the project and the governmental regulation (MOC 1993). However, the formulation needs to be approved by GPO. In the case study, the approved guidelines adopted five parameters for prequalifying the contractors, including business qualification grade, organization creditability, and reputation, working experience for similar projects, quality award received at

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Table 2. Key Data Included in Bidding Documents

Bidder number	Tender price (P) (RMB million)	Construction time (T) (day)	Quality grade (Q) (award)	Materials consumption		
				Steel (t)	Timber (m^3)	Cement (t)
1	36.38	720	National quality award	1,938	248	1,596
2	37.83	730	Provincial quality award	1,921	255	1,681
3	36.66	715	Provincial quality award	1,929	252	1,475
4	36.60	720	National quality award	2,003	264	1,739
5	36.43	730	Provincial quality award	1,938	248	1,831
6	37.83	710	Provincial quality award	1,987	240	1,756
7	36.30	725	National quality award	1,980	165	1,629
8	37.59	730	Provincial quality award	1,846	256	1,760

or above provincial level over the previous 3 years, and the qualification grade and working experience of the appointed project managers. It can be seen that these parameters are within the competitiveness parameter model defined in the previous section. By using the five criteria, eight contractors were selected for entering into the final selection process.

In the final selection, the client chose five parameters for calculating the competitiveness value of the eight selected contractors, including tendering price (x_1), project contract time (x_2), construction quality plan (x_3), the demanded quantity of the major building materials (steel, timber and cement) (x_4), and the track record in conducting similar projects (x_5). The selected tenderers submitted the required information, as shown in Table 2.

The bidding evaluation panel including seven members was formed according to the governmental regulation procurement law (NPC 2000). The regulation specifies that the number of experts in a bidding evaluation panel must be in odd number and not less than 5, including at least 2/3 randomly selected from bidding evaluation expert system, and others recommended by client. The GPO will normally have a bidding evaluation expert system where expert candidates are recruited through a formal procedure. In this case study, the GPO endorsed the evaluation panel which included five randomly selected and two recommended by the client. The panel adopted a quantitative model, as shown below, for calculating the tenderers' competitiveness score and selecting the successful tenderer who obtains the maximum score

$$C_s = \underset{i}{\text{maximum}}\{C_1, C_2, \ldots, C_i, \ldots, C_8\}$$

$$C_i = \sum_{j=1}^{5} X_{ij}$$

where C_s=competitiveness score gained by the successful contractor s; C_i=competitiveness score for contractor i; and X_{ij}=competitiveness score gained by parameter j in refer to contractor i.

When a specific contractor is concerned, each panel member was requested to assign a specific score to each of the five parameters. For assisting panel members in conducting the scoring exercise, the evaluation panel formulated the upper benchmark scores for each parameter as: $X_1^{\max}=65$, $X_2^{\max}=2$, $X_3^{\max}=3$, $X_4^{\max}=20$, $X_5^{\max}=10$. That is, the benchmark score for the parameter x_1 is 65, and so on. The benchmark scores are produced on ad hoc basis, proposed by project client and endorsed by GPO. The panel members allocated the scores based on the criteria demonstrated in Table 3. In the table, the model for allocating x_1 is widely used in the local practice (Gu 1997), and the weightings in the model are adjustable when different projects are considered. For x_2 and x_3, as all the bidders met the client's requirements (760 days for construction time and receival of quality award at provicinal level), full scores are given to all. x_4 and x_5 reflect the tenderers' competence in utilizing materials and managing similar projects. The scores for x_4 and x_5 were allocated considering both specifications defined in Table 3 and the information submitted by the tenderers. The score allocations from seven evaluation panel members were averaged, as shown in Table 4. It can be seen that contractor C_7 obtained the highest overall score of 95.86, thus it was the successful contractor.

This case study demonstrates the typical application of awarding construction contracts on a multicriteria basis in China. The method is extensively used for procuring public projects. There are shortcomings of this scoring mechanism. For example, the selection of the variables for formulating the calculation model and the distributions of scores among the five parameters are very arbitrary and on ad hoc basis. The insignificant allocation of score to construction time and quality performance can discourage the good practice of time and quality management. The practice of giving same time and quality scores to those contractors who met the client's benchmark requirements will not only present the possibility of losing best contractor but also raises the question of fairness in the competition. Nevertheless, it is believed that these shortcomings will be improved in line with the further reform of the industry, and the case study itself offers useful reference particularly for those overseas contractors who plan to develop business in China.

Conclusion

Contractor's competitiveness is used as the criterion for selecting successful bidder, thus the parameters used in assessing the competitiveness are very important for ensuring a project client to choose right contractor to do a job. This study has found that a very sophisticated set of parameters is used in the Chinese construction market for assessing contractor's competitiveness. This sophistication is suggested due to the implementation of the complicated regulation frame in the market. Proper understanding of how these competitiveness parameters are used in the Chinese market has same significance to both domestic and overseas contractors as the two types of contractors are allowed to compete on equal basis under the WTO principles. This understanding is essential for those overseas professionals who plan to develop business in China as the complicated regulation frame will remain for coming years and the governmental control over the construction market through certain administrative measures will still be effective.

The competitiveness parameters used in the Chinese construction are identified from seven attributes: management skill, tech-

Table 3. Assessment Criteria for Calculating Competitiveness Score

Assessment parameters	Maximum score	Measures and benchmarks for consideration
Price offered (x_1) $x_1=65-\frac{\lvert p_i-p_2\rvert}{p_2}\times 100\times 3 \quad (p_i>p_2)$ $x_1=65-\frac{\lvert p_i-p_2\rvert}{p_2}\times 100\times 2 \quad (p_i<p_2)$	65	The following models is adopted for considering the allocation of price scores: $P_1=0.6\times P_0+0.4\times\frac{\Sigma_{i=1}^{n}P_i}{n};\ P_2=0.95\times P_1$ where P_0=benchmark-price produced by project client; P_i=tender price submitted by contractor i; n=number of tenderers; P_1=weighed tendering price; and P_2=adjusted price. The level of a contractor's price score (x_1) depends on the difference between his tender price P_i and the adjusted prince P_2. 65 is given if there is no difference; three scores are deducted for every 1% price increase; and two scores are deducted for every 1% price decrease.
Construction time (x_2)	2	Client's requirement (760 days).
Intended quality (x_3)	3	Client's requirement (provincial quality award or above).
Construction master plan (x_4)	20	By referring to the relevant information submitted by the tenders, assessment panel members will judge and allocate scores against each of these factors listed on the left-side column in refer to each tenderer.
• Construction methods	2	
• Site organization structure	1.5	
• Mechanical facilities	1.5	
• Working staff	1.5	
• Program plan and control methods	2	
• Quality assurance methods	2.5	
• Site layout	2	
• Safety and clean construction	2	
• Application of new materials, new technology and new techniques	2	
• Technical interview	3	
Organization reputation and track records (x_5)	10	By referring to the relevant information or certificates submitted by the tenders, assessment panel members will judge and allocate scores against each of these factors listed on the left-side column in refer to each tenderer.
• Qualification grade	2	
• Previous quality awards	2	
• Clean construction	2	
• Bank credibility certificate	2	
• Credibility of committing contract	2	

nical ability, financing ability, organization structure, marketing ability, social influence, and contribution to project objectives. The formulation of the parameters provides a reference tool in assisting contractors in analyzing their competitiveness in the Chinese construction market. The practical case presented in the paper demonstrates the feasibility of using multiple parameters in the practice and offers useful experience to those overseas contractors who may consider developing business in China. The study can serve as a useful basis for conducting further comparative studies on competitiveness assessment practice under different economic environments.

Table 4. Summary of Competitiveness Scores for Eight Bidders

Bidder	X_1	X_2	X_3	X_4	X_5	Total score
C1	62.98	2	3	15.24	7.9	91.12
C2	56.20	2	3	17.54	8.8	87.54
C3	64.50	2	3	15.36	6.2	91.06
C4	63.50	2	3	16.96	9.4	94.86
C5	63.27	2	3	15.28	9.2	92.75
C6	58.23	2	3	15.78	8.9	87.91
C7	**63.54**	**2**	**3**	**17.52**	**9.8**	**95.86**
C8	56.15	2	3	15.70	6.6	83.45

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