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## Investigation of barriers to entry into the design-build market in the People's Republic of China (PRC)

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## Abstract

Although the design-build (DB) system has been demonstrated to be an effective delivery method and has gained popularity worldwide, it has not gained the same popularity in the construction market of China. The objective of this study was, theretofore, to investigate the barriers to entry in the DB market. A total of 22 entry barriers were first identified through an open-ended questionnaire survey with 15 top construction professionals in the construction market of China. A broad questionnaire survey was further conducted to prioritize these entry barriers. Statistical analysis of responses shows that the most dominant barriers to entry into the DB market are, namely, lack of design expertise, lack of interest from owners, lack of suitable organization structure, lack of DB specialists, and lack of credit record system. Analysis of variance indicates that there is no difference of opinions among the respondent groups of academia, government departments, state-owned company, and private company, at the 5% significance level, on most of the barriers to entry. Finally, the underlying dimensions of barriers to entry in the DB market were investigated through factor analysis. The results indicate that there are six major underlying dimensions of entry barriers in DB market, which include, namely, the competence of design-builders, difficulty in project procurement, characteristics of DB projects, lack of support from public sectors, the competence of DB owners, and the immaturity of DB market. These findings are useful for both potential and incumbent design-builders to understand and analyze the DB market in China.

Key word: design and build; barriers to entry; construction market; factor analysis; China

## 1. Introduction

Design-build (DB) is a procurement method where one entity or consortium is contractually responsible for both design and construction of a project (Songer and Molenaar, 1997). This integrated delivery system has been demonstrated to be an effective delivery method and has gained popularity worldwide (Konchar and Sanvido, 1998). According to the Design-Build Institute of America (DBIA, 2005), an association founded in 1993 to promote the application of DB system, about 40 percent of all nonresidential construction projects in both public and private sectors in the United States used this approach. It is also estimated that the DB system will be the leading method of project delivery by 2010.

The DB system, however, has not been widely used in the construction market of the People's Republic of China (PRC). In 2006, less than 10 percent of the construction projects were delivered in DB method (China Construction Industry Association, "CCIA", 2006). The total value of the DB contract, undertaken by the top 100 design consultants and the top 60 contractors, takes up less than 5 percent of the total output of the construction industry.

In exploring potential reasons attributing to this situation, the theory of barriers to entry provides an insightful perspective to analyze the DB market. Barriers to entry include anything that makes it difficult for a new entrant to enter into a market. Oster (1990) described barriers to entry as industry characteristics that reduce the rate of entry of new firms. It is regarded that any kind of entry barrier is a distortion of the competitive process (Yang, 1998). In industrial economics, there are various sources of barriers to entry, which include absolute cost advantages, economics of scale, high capital requirements, product differentiation, the degree of firm concentration, market risk, experience or learning curve, industry regulation, and the size and expected growth of the market (Bain, 1956; Mann, 1966; Porter, 1980; Baldwin *et al.*, 1995). These barriers keep the number of companies competing in an industry small, and allow the incumbent firms to earn higher-than-normal profits (Avgeropulos, 1998). Therefore, understanding

sources of barriers to entry in an industry is of significant importance to both potential entrants and incumbent companies.

In the DB market of the PRC, several obstacles to the application of the DB system have been identified. In 2004, the Ministry of Construction (MoC) conducted an investigation on the environment of the domestic DB market. The investigation report shows that although the DB system has developed rapidly in China in the recent years, it encountered several major obstacles, which included the imperfection of the legal and regulatory systems, the lack of recognition from owners, and the in-competence of DB contractors. Even though MoC's investigation provided some insights to the barriers to entry in the DB market, it is believed that a more detailed analysis should be conducted to capture the changes resulting from the rapid economic development in the PRC's domestic and international markets.

Therefore, the purpose of this study is to identify and analyze the dominant barriers to entry in the current DB market of the PRC. To address this, a questionnaire survey approach was adopted. This paper is organized in two parts. Part one provides an introduction to the generic barriers to entry in terms of industrial economics; the second part describes the development and implementation of the questionnaire for the study.

## **2. Literature review---Barriers to entry**

The concept of barriers to entry was first introduced by Bain (1956). It was advocated that the existence of barriers can aid market incumbents in limiting the intensity of competition in their respective industries and therefore enable them to have above-average profitability. Bain (1956) identified economies of scale, product differentiation, and absolute cost advantages of established firms as major determinants of the barriers to entry. Porter (1980) has written extensively on barriers to entry, and proposes six major sources of barriers, which include cost advantages of incumbents, product differentiation of incumbents, capital requirements, customer switching costs, access to distribution channels, and government policy. Over the past decades, several other sources of barriers

have been identified including, for example, advertising (Demsetz 1982; Harrigan 1981), research and development (R&D) (Schmalensee 1983), patents (Mansfield et al., 1981), market risk (Baldwin et al., 1995), and the size and expected growth of the market (Baldwin et al., 1995).

Although there are diverse sources of barriers to entry, the industrial organization and strategic management theory suggests that (1) economies of scale, (2) capital requirements, and (3) product differentiation are the most important entry barriers (Bain, 1956; Hay and Morris, 1991; Hofer, 1975; Porter, 1980; Shepherd, 1975; Siegfried and Evans, 1994). In this section, these three barriers to entry are therefore specifically reviewed.

### ***Economies of scale***

The effect of economies of scale exists when a decline in product cost is accompanied by an increase in product output. It represents efficiencies in production that cannot be easily achieved by new entrants. Many researchers (Bain 1956; Stigler, 1968; Faulkner, 2002) argue that the effects of economies of scale in any industry are strongly associated with large firm size. When the plant scale increases, the unit cost of a product declines as a result of, inter alia, design characteristics, favorable access to raw materials, government subsidies, and learning or experience curve (Karakaya and Stahl, 1989).

### ***Capital requirements***

The capital requirement constitutes barrier to entry when companies need to invest large financial resources in order to compete or enter a market. Generally, such barrier is higher in capital-intensive industries. It is suggested that new entrants will encounter difficulties in raising capital, locating and training a qualified workforce, and developing inventories and distribution channels in order to build an appropriate sized plant (Geroski et al., 1990).

### ***Product differentiation***

Product differentiation is the ability of a firm to establish brand identification that represents a barrier to new entrants (Dickinson, 2006). The established firms have brand identification and customer loyalties due to advertising, being first in a market, customer service, or product differences. Cave and Porter (1977) asserted that product differentiation reduces the likelihood that customers will switch to competitor's products. Thus, entrants must persuade consumers to compare products with different specifications and then to re-evaluate their purchasing habits.

Extensive economic theory on barriers to entry demonstrates how various elements of industry structure impose disadvantages on entrants. Meanwhile, it should be noticed that the barriers to entry vary from industry to industry. In addition, even for the same industry, the barriers to entry will also vary in different geographical locations and over different economic development stages. Therefore, this study focuses on identifying the contemporary barriers to entry in the DB market of the People's Republic of China.

### **3. Research methods**

The focus of this research work is to identify the contemporary barriers to entry into the DB market of the PRC. Two rounds of questionnaire survey were conducted. An open-ended questionnaire survey was first conducted with 15 professionals through e-mails and phone-calls. All these experts have sufficient DB knowledge, and extensive hands-on DB experience. They were requested to list down barriers to entry into DB market according to their experience. In particular, they were requested to take into consideration of the unique characteristics of the PRC construction industry. The findings from the literature review were also provided for their reference. Content analysis was employed to identify the key competences of DB contractors after the collection of their responses. It is often used to determine the major facets of a set of data, by simply counting the number of times an activity happens, or a topic is depicted (Fellows and Liu, 2008). After

employing the content analysis, the open-ended questionnaire survey resulted in a final list of 22 barriers to entry into the DB market in China.

In order to prioritize and evaluate these barriers to entry, another questionnaire survey was conducted with experts in the DB market. A total of 435 respondents were identified, which are from the groups of academics, government departments, state-owned companies, and private companies in the construction industry. In order to ensure the validity of the survey results, all the respondents should have more than 5 years working experience in the construction industry. In addition, they should have been involved in DB projects in China. In this questionnaire survey, the respondents were requested to provide opinion on the extent of influence/importance of each barrier to entry into DB market on a five-point Likert-type scale, which ranges from 1 (the least important) to 5 (the most important). Finally, a total of 140 responses were received. The response rate was 32%, which is very encouraging considering the fact that the DB system has not been widely used in the PRC.

#### **4. Analysis of the First Questionnaire Survey**

Questionnaire surveys by email are a widely-used survey mode. It has demonstrated superiority over postal surveys in terms of response speed and cost efficiency. E-mail survey provides an easier and more immediate means of response, and a potential decrease in delivery time and cost (Schonlau et al., 2002). In this email questionnaire survey, open-ended questions were used in order to solicit experts' opinions on the barriers to entry into the DB market of China. The findings in the literature review were also provided for their reference.

Given the unique situation of the DB markets in China, all the experts should satisfy following selection criteria.

- (1) The expert should have at least 5 years hands-on DB experience
- (2) The expert should have publications in the DB field to show their extensive DB knowledge

Questionnaires were sent to 31 experts who met all the selection criteria. Finally, 15 valid responses were received. A list of the final respondents and their affiliations are shown in Table 1. The respondents represent a wide spectrum of construction professionals in the PRC and provide a balanced view for the study.

**Please insert Table <1> here**

Among the final respondents, each of them had at least one publication in the academic journals in the DB field. In addition, all of them had sufficient experience and expertise in the DB field. The average DB experience is 10 years. Most of them (53%) had 5-10 years DB experience. One-third of respondents (33%) had 10-20 years of DB experience, and the rest of them (13%) had over 20 years experience in the DB field.

The open-ended questionnaire survey was conducted as an exploratory process and is of crucial importance. After the completion of the questionnaire survey, content analysis was used to identify the barriers to entry into the DB market in China. Weber (1990) stated that content analysis could help classify textual material, reducing it to more relevant, manageable bits of data. In conducting the content analysis in this research study, all the key points and main ideas of each survey transcript were first documented. Then, similar main points and ideas were assembled and different main themes were finally consolidated from the analyzed survey transcripts. After the analysis, a total of 22 main themes of the barriers to entry into DB market were identified (shown in Table 2).

**Please insert Table <2> here**

## **5. The Second Questionnaire Survey**

### **5.1 Questionnaire development**

After the open-ended questionnaire survey, the consolidated twenty-two barriers to entry



into the DB market were used in the second questionnaire survey. Respondents were asked to evaluate the importance of the barriers to entry on a 5-point scale, where 1=not important, 2=somewhat important, 3=important, 4=very important, and 5=extremely important or essential. A total of 435 respondents were identified from government departments, contractor associations, and construction-management departments in universities. The questionnaires were sent to them by email. A total of 140 responses were finally received, getting a response rate of 32%. To ensure that the survey results were credible, any replies from respondents with less than 5 years of experience in construction industry were discarded. However, the results revealed that all the respondents have more than 5 years working experience, and most of them (86%) have been working in the construction industry for more than 10 years. All the respondents have been involved in DB projects, and 80% of them have the DB experience for more than 5 years. The details of the 140 respondents are summarized in Table 3 and Table 4. In addition, it should be pointed out that although the experts from academia take up more than 50% of the respondents, most of them have close connections to the industry and provide consultancy services to contractor agencies and government departments in DB projects.

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**Please insert Table <4> here**

## **5.2 Data analysis and discussion**

Two separate statistical analyses were undertaken using the SPSS software. The first analysis ranked the barriers to entry based on mean value of responses, compared the mean for different groups of respondents and provided an analysis of variance (ANOVA), which test the null hypothesis that the mean of the individual barrier to entry is equal in different groups.

The second analysis was intended to explore and detect the underlying relationship

among these barriers to entry into DB market using factor analysis. Factors analysis is a statistical technique used to examine the underlying patterns or relationships for a large number of variables and to determine whether or not the information can be condensed or summarized into a smaller set of factors or component (Norusis, 1992). The principal component analysis for factor extraction was used in the analysis. It considers the total variance in the data, and determines the minimum number of factors that will account for the maximum variance in the dataset.

### **Analysis and ranking of barriers to entry into the DB market in China**

As part of the analysis, the reliability analysis was first conducted. Reliability analysis is to test whether the instrument will produce the same result each time it is administered to the same person in the same setting. Coefficient alpha (Cronbach's alpha) is designed as measures of internal consistency. In this study, the Cronbach's coefficient alpha was 0.801, which suggests that the 5-point Likert-type scores provided by the respondents in the study are reasonably reliable.

The analysis of mean values of the barriers to entry into the DB market, shown in Table 5, suggests that the five most dominant barriers to entry (whose mean scores are 4.0 or above, which means "very important") include, in rank order, Lack of design expertise of contractor-led design-builders, Owners' lack of interest toward DB system, Lack of suitable organization structure, Lack of DB specialists, and Lack of credit record system in the construction market. As DB contractors assume total responsibility for a DB project, they should possess the ability to combine the design and construction functions successfully. However, the majority of design-builders were developed from general contractors, lacking sophisticated design expertise in China. In addition, because the development of DB system is still in its infancy stage, many DB contractors lack enough DB specialists and suitable organizational structures to deliver the DB projects. In the construction market of China, although many owners have recognized the advantages of the DB system, many of them—especially the owners of the public sector—have no strong incentives to adopt this new alternative. This is mainly because owners have been

used to the traditional delivery system and many of them still have concerns about the DB system, such as losing control of DB projects. Furthermore, due to the lack of a credit record system in the construction market, many owners are unwilling to adopt a DB system because it is not easy to find the reliable DB contractors. Therefore, it is not surprising that these factors were on the top of the ranks as barriers to entry into the DB market in China.

With the exception of the (1) Lack of interest from owners, (2) Lack of competent design-builders, (3) Lack of qualification regulations, (4) Conflicts with existing bidding law, and (5) Coordination with sub-contractors, there is no statistically significant difference in the opinions of the respondents from different groups, at 5% significant level. This suggests that, experts in universities, government departments, state-owned companies, and private company, generally have similar opinions regarding the factors constituting barriers to entry into the DB market of China.

In order to explore which groups have different opinions toward these barriers to entry, a multiple comparison of Bonferroni Post-Hoc test was conducted. Pairs of groups, whose mean scores are significantly different from each other, are shown in Table 6. It can be seen that the group of State-owned companies have different opinions from Private companies on the following barriers to entry, which include the Lack of qualification regulations and Coordination with subcontractors. The reason why these barriers were ranked higher in the group of State-owned companies is that many of them often get involved in large-size DB projects in the public sector; and these large projects usually require the highest grades of enterprise qualifications and sophisticated coordination with a variety of specialty contractors.

Conflict with existing bidding law was ranked 22 by the Academic group, but it was ranked higher (14) in the group of Government department. Many experts in government believe that the DB method may give rise to conflicts with competitive bidding laws. This is because projects in the public sector usually require a competitive process to appoint a contractor, and some local statutes and regulations are subject to a mandatory

requirement to obtain competitive bids on the basis of price. The price-oriented process of contractor selection may not be suitable for DB projects; it may prevent the owner to obtain the best value of the DB projects. It is therefore recommended that government departments responsible for policy-making should consider launching new laws that authorize and regulate the procurement of DB projects.

The lack of a suitable organizational structure was ranked as the most dominant barrier by both state-owned and private companies compared with the rank of 12 by Government departments and the rank of 6 by Academics. A suitable DB organization format is critical to contractors when conducting DB projects. This is because most of them are not integrated design-builders. They need to collaborate with other companies to possess both design and construction functions. However, this is very difficult for most of contractors and designers due to the complexity in the allocation of project risk and responsibility.

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**Please insert Table <6> here**

#### **Underlying dimension of barriers to entry—factor analysis**

In order to reduce the number of barriers and detect structure in the relationships between barriers, factor analysis was used for the research purpose. Factor analysis is commonly used to define dimensions underlying existing measurement instruments. It requires two essential stages, factor extraction and factor rotation (Norusis, 1992). The primary objective of the factor extraction is to make an initial decision about the number of factors underlying a set of measured variables. The objective of the second stage is to make the factors more interpretable and make final decisions about the number of underlying factors.

The 22 barriers to entry were subjected to factor analysis, with principal components

analysis for factor extraction and varimax method for factor rotation. In order to evaluate the appropriateness of the factor extraction, the Kaiser-Mayer-Olkin (KMO) measure of sampling accuracy and Barlett's test of sphericity were conducted. The KMO measure of sampling adequacy tests whether the partial correlations among variables are small. Kaiser (1974) recommended KMO values of greater than the threshold of 0.5 as acceptable. The results show that KMO measure is .686, which is greater than 0.5 for a satisfactory factor analysis to proceed. Bartlett's test of sphericity is used to test the null hypothesis that the variables in the population correlation matrix are uncorrelated. The observed significance level was .000, and thus the null hypothesis was rejected. It is concluded that the strength of the relationship among variables is strong and therefore a factor analysis for analyzing the data can be proceed.

**Please insert Table <7> here**

## **Discussion of factors analysis results**

### ***The competence of design-builders***

As the key stakeholders in DB projects, design-builders play a vital role in the delivery process because they take full responsibilities of design and construction, and take control of the project management. Many studies have reflected that the competences of design-builders are critical to the success of DB projects. Molenaar and Songer's (1998) multi-attribute analysis and retrospective case studies found that DB contractor's experience is crucial for successful DB projects in the public sector. Chan *et al.* (2001) conducted multiple regression analysis in Hong Kong and found that DB contractor's competences are important to bring successful DB project outcome. Lam *et al.* (2008) conducted multiple regression analysis and identified that the competence of the design-builders is one of the determinants of the successful DB projects. Puterto *et al.* (2008) asserted that owners are willing to pay more to get highly competent DB contractors. All

these research studies advocate that a competent DB contractor could ensure the success of DB projects.

In the construction market of the People's Republic of China, however, the majority of DB contractors lack adequate competences to execute the DB projects successfully. According to the China Construction Industry Association (2006), the total value of the DB contract, undertaken by the top 100 design consultants and the top 60 contractors, takes up less than 5 percent of the total output of the construction industry. The lack of sufficient DB competence of design-builders is regarded as one of the major obstacles to the application of DB system in China (Xun, 2003; Zheng and Cheng, 2004). DB contractors should, therefore, exploit their resources and capabilities to build up their competence and establish the competitive advantages in the DB market.

### ***Difficulty in project procurement***

The project procurement represents the purchasing steps that owners or their representative must take to gain the service and commodities as required (Beard et al. 2001). In order to procure the satisfactory DB projects, owners or their representatives should be able to define what they want clearly through the requests for proposals. However, it is never an easy task. Owners are required to clearly define the project scope and expected outcomes in advance of the procurement selection. Otherwise it can be very costly if the information provided by the owner to the contractor at the outset of the DB process is not correct (Mogaibel, 1999). At the same time, owners should stop short of describing how to get there for it may preclude the DB team from any significant creativity and innovation (Quatman and Dhar, 2003).

The selection of DB contractor is also a difficult task in DB projects. Firstly, there are different levels of competition, from open tendering to single negotiation in the contractor selection process. Owners have to decide whether a project is suitable for competitive tendering or a more co-operative process where non-price criteria play a significant part. Secondly, it is very difficult to evaluate the DB competence of potential

contractors because many selection criteria for design-builders are qualitative, subjective and imprecise (Fong and Choi, 2000). As a result, most of the owners in China tend to select the design-builders on a price-oriented basis, which may not be suitable for DB projects.

### ***The characteristics of DB projects***

The execution of the design-build system is quite different from the traditional way. In the DB process, most of the construction work starts before the total completion of the shop drawings, thus causing a large fluctuation in the labor force and material supply (Ernzen and Schexnayder, 2000). It will, in turn, not only require a demand for huge capital scale of the DB contractors but also incur higher risk to the design-builders because most of the DB contracts are awarded on a lump-sum basis. As a result, the contract prices of DB projects are usually higher than the similar projects with traditional delivery system in China. In addition, the cost estimation for a DB project is very difficult because the design documents are often preliminary and may change over the course of the project. Estimates should be accurate and reasonably verifiable in order to minimize risk. Only the bigger companies with diverse skills and resources may set up the estimation system for the DB contract competently.

As an alternative delivery method, the DB system offers many strengths or advantages such as single-point responsibility, time saving, enhanced financial certainty, improved buildability, and reduced disputes (Rowlinson 1997; Leung 1999). Although various empirical studies overseas have indicated that DB system is superior to traditional delivery system in regards to time and cost (Konchar and Sanvido, 1998; Hale *et al.*, 2009), the effectiveness of DB system in China, is yet to be demonstrated. The main reason is that the DB market is still at the infancy stage, and most of the stakeholders lack the experience to conduct the DB project successfully. However, given the prosperous construction industry and strong promotion from the government; it is believed that the DB market will have great potential in the future.

### ***Lack of support from the public sector***

In the recent years, the central government has been promoting the DB system with great efforts. However, this alternative system is not favored by the local governments. It is mainly because most of the local governments lack the experience in administrating this new system due to the lack of tendering procedure, licensing regulations, and standard contract forms for the DB system in the PRC construction market. Furthermore, some local governments still keep traditional perspectives to the DB system. For example, they always require a competitive bidding in DB projects on the basis of price. However, the price-oriented process is not always suitable for DB projects and may prevent the owner to obtain the best value of the DB projects.

In public sector, a majority of owners still prefer the traditional delivery system. Firstly, they have got used to the design-bid-build system, which has long dominated the construction market. Second, many public owners have the concern that their interests may not be well protected if the projects are under the control of design-builders. In addition, due to the traditional investment system in China, many owners in government-invested projects have no responsibility for the overruns of budgets and construction time. As a result, the public owners take less interest in adopting the DB system despite its theoretical advantages and strong promotion from the central government.

### ***The competence of owners***

DB system provides owners with a number of advantages. At the same time however, the owners are also required to possess certain competences to manage the DB projects. For example, owners should be able to clearly define the project requirements (Kometa et al., 1995; Mo and Ng 1997; Songer and Molenaar 1997; Lam et al. 2008); have the ability to manage design changes (Deakin, 1999; Pearson and Skues 1999); have adequate staffing to coordinate with the other participants (Songer and Molenaar 1997, Ling and Liu, 2004), and have the similar design-build experience in the past (Mo and Ng, 1997, Molenaar and Songer, 1998; Ling and Liu, 2004; Lam et al. 2008). These new requirements of DB



projects pose challenges to most of the owners, and may discourage them to attempt using the DB system. It will take time for owners to fully accept this new system in the construction market of China.

### ***The immaturity of the design-build market***

In the PRC, the DB delivery system was first introduced into the Petroleum and Chemistry industry in the late 1980s and then spread to the metallurgical industry, electronic industry, infrastructure construction, and housing industry. Although it has witnessed rapid growth in the recent years, the development of the DB system is still at its infancy stage. In the construction market of China, there have been no specific laws or ordinances on the DB delivery system. The existing laws including the *Construction Law*, *Tendering Law* and *Construction Quality Management Ordinance* only have regulations on exploration, design, construction, and construction supervision. The legal system constitutes one of the major obstacles to the promotion of DB system.

In addition to the lack of specific laws and regulations on the DB method, there are not enough competent design-builders in the DB market. Most of the DB projects in China are large and multidisciplinary, it requires the design-builders to have combined design and construction functions, sophisticated human relationship skills, and adequate staff dedicated to the project. However, many design-builders are not competent enough to conduct DB projects successfully. As a result, the public owners take less interest in adopting the DB system despite its stated advantages and strong promotion from the central government. Furthermore, considering that there is no matured credit record system in the DB market, many owners are reluctant to leave the whole project to the design-builder in one single-point contract. They may have the concern that their interests may not be well protected if the projects are under the sole control of design-builders.

## **6. Significance and limitations**

The DB method has a variety of advantages, and can theoretically bring benefits to various stakeholders. In the construction market of China, however, it has not been

widely used yet. This study focuses on exploring potential reasons attributing to this situation adopting the theory of barriers to entry. Twenty two barriers to entry in the DB market of China have been identified and the importance of each has been examined through two rounds of questionnaire survey. The research findings furnish the DB stakeholders with perspectives to better understand and analyze the DB market. Based on the results, the government, owners, and DB contractors can take corresponding approaches to overcome the barriers and promote the application of DB system in China.

Similar to any other opinion-based research study, the approach used may be influenced by a degree of subjectivity, bias, imprecise definition, and human inability to process complex information. In addition, the number of responses in the groups of government departments and private companies are relatively small. It may provide a perception of over-reliance on academia's views. However, the effects of these limitations can be further reduced by taking a larger sample size in a future questionnaire survey.

## **7. Conclusions**

The focal point of this analysis was to examine the barriers of entry into the DB market of China. Twenty two ranked entry barriers have been identified through a comprehensive literature review and questionnaire survey. The underlying dimensions of these factors have also been examined. The findings indicate that the Competence of design-builders, Difficulty in project procurement, the Characteristics of DB projects, Lack of support from the public sector, the Competence of owners, and the Immaturity of DB market constitute the main barriers to entry into the DB market of China.

The research findings of this study provide some practical implications, especially for the potential DB contractors. For most of the contractors, the lack of design expertise is the main barrier to entry into the DB market. Therefore, the collaboration with experienced design consultant is essential to the success of their first project if in-house competencies are not available. In addition, before market entry decision is made, it is highly beneficial for those companies to assess the existence and importance of barriers to entry and how

to overcome them. Another important recommendation for DB clients is that when selecting the appropriate DB contractors, they should pay more attention to the qualifications of potential contractors, such as the DB experience, organization structures and DB specialists in order to get the best value rather than the lowest price of the DB contract.

The research findings of this study also imply that the barriers to entry would vary in different conditions of DB markets. For instance, in the Chinese construction market, the lack of a mature credit record system is regarded as the dominant barrier to entry. However, this problem most probably does not exist in mature DB markets. Therefore, further research should be conducted in other geographical locations to find out their similarities and differences for international comparisons. Such research findings will be of great importance to international design-builders when considering entering into a new DB market in other parts of the world.

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Table 1 List of the panel of experts for the first questionnaire survey

Type of firm / department	Number
Government department	2
Design consultant company	3
Project management company	3
University	3
Construction company	4
Total	15

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Table 2 Summary of barriers to entry into the design-build market in China

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1. Lack of promotion from the local government
2. Unfamiliarity of the DB owners
3. Lack of enough competent design-builders
4. Lack of experience of design-builders
5. Difficulty in determining the DB contract price
6. Lack of interest from public owners
7. Lack of sophisticated design expertise of contractor-led design-builders
8. Lack of project management capability of designer-led design-builders
9. Lack of enough design-build professionals in the DB market
10. Owner's lack of ability to successfully define project requirements
11. Lack of credit system in the construction market
12. Lack of competent sub-contractors
13. Lack of suitable organization format for design-builders
14. Difficulty in coordination with sub-contractors
15. Higher contract price of DB projects
<i>The contract price of DB projects is comparatively higher than traditional design-bid-build projects</i>
16. Lack of bidding and evaluation method for DB projects
<i>There are only bidding regulations on exploration, design, construction, and construction supervision</i>
17. Risk management of design-build projects
<i>The risk of DB projects is comparatively higher, and there is a lack of risk management approaches.</i>
18. The effectiveness of design-build system
<i>The effectiveness of DB system are not obvious compared with other delivery system in China</i>
19. Less control of DB projects
<i>Many owners have concern that a DB system will result in less control of their projects</i>
20. Lack of regulations on qualification management
<i>There is a lack of licensing regulations on design-builders in China</i>
21. Lack of real owners in public sectors
<i>Many public owners take no responsibility for the performance of projects</i>
22. Conflict with existing bidding system
<i>Most of public projects require open bidding and many even require absolute lowest-price bidding.</i>

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Table 3 Respondent classification by years in the construction industry and DB field

Working Years	Working experience in construction industry (%)	Working experience in design- build market (%)
1-5 years	--	20
5-10 years	16	37
10-20years	42	32
More than 20 years	42	11

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Table 4 Respondent classification by working organizations and working area

Working organizations		Working area	
University	58 %	Residential and Building	62 %
Government	10 %	Heavy construction	19 %
State-owned company	21 %	Industrial	19 %
Private company	11 %		

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Table 5 Barriers to entry into the DB market of China

Barriers to entry	Overall Mean	Rank	Academic	Rank	Government department	Rank	State-owned company	Rank	Private company	Rank	<i>p</i> -value
1. Lack of design expertise	4.03	1	4.12	1	4.00	4	3.83	6	3.93	3	.509
2. Lack of interest from owners	4.03	2	3.98	5	4.29	2	4.30	2	3.53	8	.043
3. Lack of suitable organizational structure	4.01	3	3.93	6	3.57	12	4.40	1	4.13	1	.052
4. Lack of DB specialists	4.01	4	4.02	2	4.07	3	4.00	4	3.87	4	.952
5. Lack of credit record system	4.00	5	3.88	8	4.57	1	4.17	3	3.80	7	.069
6. No real owners in public sectors	3.93	6	4.01	3	4.00	5	3.73	9	3.80	6	.571
7. Lack of construction management ability	3.90	7	3.99	4	3.64	8	3.97	5	3.53	9	.310
8. Lack of DB experience	3.81	8	3.93	7	4.00	6	3.70	11	3.20	14	.080
9. Unfamiliarity of owners	3.75	9	3.75	9	3.64	9	3.73	10	3.87	5	.964
10. Too much control of the owner	3.68	10	3.70	11	3.71	7	3.83	7	3.20	15	.292
11. Lack of support from local government	3.56	11	3.57	12	3.64	11	3.30	13	4.00	2	.267
12. Lack of competent design-builders	3.51	12	3.73	10	3.21	15	3.43	12	2.73	18	.008
13. Uncertainty of DB contract price	3.35	13	3.37	13	3.57	13	3.23	14	3.27	12	.828
14. Higher risk of DB projects	3.31	14	3.32	14	3.64	10	3.10	16	3.40	11	.499
15. Lack of qualification regulations	3.26	15	3.19	16	3.21	16	3.77	8	2.67	20	.018
16. Effectiveness of DB projects	3.12	16	3.25	15	3.14	17	2.93	19	2.80	17	.359
17. Difficulty in writing design-build RFPs	3.12	17	3.14	17	3.00	18	3.20	15	3.00	16	.908
18. Lack of contractor selection methods	3.03	18	3.02	18	2.86	20	3.00	17	3.27	13	.766
19. Higher contract price of DB projects	2.99	19	2.96	19	2.93	19	2.93	18	3.47	10	.224
20. Conflicts with existing bidding law	2.56	20	2.40	22	3.43	14	2.50	21	2.73	19	.022
21. Coordination with subcontractor	2.48	21	2.49	20	2.07	21	2.87	20	2.00	22	.010
22. Lack of specified sub-contractors	2.37	22	2.44	21	2.00	22	2.37	22	2.33	21	.612

Note: \*. The mean difference among groups is significant at the .05 level

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Table 6 Multiple comparison of Bonferroni Post-Hoc test--groups with different opinions

Barriers to entry with different opinions	Pairs of groups with different opinions	<i>p</i> -value
Lack of competent design-builders	Academic and Private company	.007
Lack of qualification regulations	State-owned company and Private company	.016
Conflicts with existing bidding law	Government and Academic	.015
Coordination with sub-contractors	State-owned company and Private company	.024

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Table 7 Factor profile of barriers to entry into the DB market of China

Details of the factors and barriers to entry	Factor loading	Variance explained
<i>Factor 1: The competence of design-builders</i>		12.764%
Lack of DB experience	.500	
Lack of design expertise	.838	
Lack of construction management ability	.701	
Lack of DB specialists	.636	
Lack of suitable organizational structure	.578	
<i>Factor 2: Difficulty in project procurement</i>		11.854%
Difficulty in writing request for proposals (RFPs)	.563	
Lack of bidding and contractor selection method	.554	
Conflicts with existing bidding law	.533	
Lack of specialty contractors	.788	
Difficulty in coordination with specialty contractors	.681	
<i>Factor 3: Characteristics of DB projects</i>		9.392%
Higher price of DB contracts	.588	
Uncertainty of DB contract price	.600	
Higher project risk of DB projects	.575	
Effectiveness of DB method	.732	
Less control of projects for the owners	.470	
<i>Factor 4: Lack of support from public sectors</i>		8.541%
Lack of promotion from local government	-.515	
Lack of interest from public owners	.752	
Lack of qualification regulations	.624	
<i>Factor 5: The competence of owners</i>		7.606%
Unfamiliarity of owners	.688	
No real owners in public sectors	-.524	
<i>Factor 6: Immaturity of DB market</i>		7.228%
Not enough competent design-builders	.700	
Lack of credit record system in the DB market	.506	
Cumulative variance explained = 57.386%		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.686		
Significance of Bartlett's Test of Sphericity = 0.000		

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