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Identification of key competences of design-builders in the construction market of the People's Republic of China (PRC)

Abstract

Design-builders play a vital role in the success of DB projects. In the construction market of the People's Republic of China, most of the design-builders, however, lack adequate competences to conduct the DB projects successfully. The objective of this study is, therefore, to identify the key competences that design-builders should possess to not only ensure the success of DB projects but also acquire the competitive advantages in the DB market. Five semi-structured face-to-face interviews and two rounds of Delphi questionnaire survey were conducted to identify the key competences of design-builders. Rankings have been assigned to these key competences on the basis of their relative importance. Six ranked key competences of design-builders have been identified, which are, namely, (1) experience with similar DB projects; (2) capability of corporate management; (3) combination of building techniques and design expertise; (4) financial capability for DB projects; (5) enterprise qualification and scale; and (6) credit records and reputation in the industry. The design-builders can make use of the research findings as guidelines to improve their DB competence. These research findings will also be useful to clients during the selection of design-builders.

Key words: Design and build, Procurement, Competitive advantages, Competence, Delphi method, China

Introduction

Design-build (DB) is a delivery method in which the design-builder is contractually responsible for both design and construction works (Songer *et al.*, 1997). Various empirical studies 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). It has gained popularity overseas in recent years (Haque *et al.*, 2001). 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.* (2001a) conducted multiple regression analysis in Hong Kong and found that DB contractor's competences are important to bring successful DB project outcome. Ling *et al.* (2004) used Neural Network to predict the performance of DB projects in Singapore and concluded that the competences of DB contractors are the key variables affecting the performance of DB projects. 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 DB contractor should be competent enough to ensure the success of DB projects.

In the construction market of the People's Republic of China, the DB system has yet to be widely used. In 2006, less than 10 percent of the construction projects were delivered in the 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. The majority of DB contractors lack adequate competences to execute the DB projects successfully. It 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 become competent enough and establish the competitive advantages in the DB market.

This study aims to identify the key competences of design-builders that function as sources of competitive advantages in the construction market of the People's Republic of China. A literature review on the relationship between firm-specific competences and competitive advantages was first undertaken. Then semi-structured face-to-face interviews with five experts were conducted to solicit their views on the potential key competences of design-builders in the construction market of China. Finally, a two-round Delphi questionnaire survey was carried out with another group of twenty experts to identify the key competences of design-builders. It is expected that this research study will provide design-builders insights how to establish competitive advantages in the DB market and further enrich their knowledge of the DB system.

Literature review

Design-builders play a vital role in the delivery of DB projects. Achieving and maintaining a competitive advantage is essential for the success of design-builders. The competitive advantage is an advantage over competitors, which enables the firms to create superior value for its customers and superior profit for itself (Porter 1985; Barney, 1991). A sustainable competitive advantage occurs when the firm is implementing a value creating strategy not being implemented simultaneously by rivals and other firms are unable to duplicate the benefits of this strategy (Barney, 1991).

Competitive advantages can be derived from a variety of sources. The traditional competitive force theory (Porter, 1985) asserts that in order to gain competitive advantages, a firm must exploit external market forces and position itself in relation to the generic strategies –low cost, differentiation, and focus. The limitation of Porter’s theory is that it fails to address the firms’ unique resources and capabilities as competitive edges (Hafeez *et al.*, 2002). It is assumed in the competitive force theory that firms are homogeneous in their stocks of assets and capabilities (Barney, 1991).

By contrast, the resource-based view (Barney, 1991; Newbert, 2008; Powell, 2001; Wernerfelt, 1984) and competence-based view (Prahalad and Hamel, 1990; Sanchez and Heene, 1997 and 2003) argue that firms are heterogeneous to one another because they possess some unique resources and capabilities. In addition, the heterogeneity of the resource and capability may not be perfectly mobile across firms and the heterogeneity

can be long-lasting. Therefore the sustainable competitive advantage is acquired by exploiting, accumulating, and maintaining these unique resources and capabilities.

Another firm-level theory--the dynamic capabilities approach—also recognizes that dimensions of firm-specific capabilities can be sources of competitive advantage (Teece *et al.*, 1997). It stresses exploiting existing internal and external “dynamic competences”, which is “the capacity to renew competencies”, so as to address changing environment and maintain the long term competitiveness. This approach emphasizes the development of management capabilities, and difficult-to-imitate combination of organizational, functional, and technical skills.

It is well observed that all the resource-based view, competence-based view and dynamic capabilities approach advocate that firms should exploit or redeploy their resources and competencies. Furthermore, the dynamic capabilities approach advocates internal as well as external cooperation for developing or acquiring such key competence/capabilities to obtain the sustainable competitive advantages. It is especially in line with the recent globalization and outsourcing trends (Hafeez *et al.*, 2002). In the DB market, with the rapid development of construction techniques, diversified requirement from the owners, and complicated coordination with various subcontractors, it is of great importance to identify the key competences of design-builders that function as the sources of competitive advantages in the DB market.

Several major studies have identified a variety of capabilities of DB contractors that contribute to the success of DB projects. These capabilities do not necessarily constitute the key competences of design-builders, but may serve as the potential sources of the competitive advantages in the DB market. Songer and Molenaar (1997) and Molenaar and Songer (1998) found that the contractor's DB experience is one of the vital factors contributing to the success of DB projects. Chan *et al.* (2001a) conducted multiple regression analysis and concluded that the DB contractor's competencies to (1) utilize special/innovative building techniques and materials to speed up building process; (2) input building knowledge in design development; (3) have good project management capability for design-build project; and (4) have a thorough understanding of the design process, are important for successful project outcome. Beard *et al.* (2001) indicated that the only requirements to be a design-builder are to have financial and management capabilities to accept the risk and undertake the responsibilities.

Ling *et al.* (2004) stressed that the contractor's competences are positively related to the success of the DB projects. Those competences include (1) contractor's key personnel's management ability; (2) contractor's ability in financial management; (3) contractor's health and safety management capability; and (4) contractor's technical expertise. Ling and Liu (2004) suggested that to ensure the project success, DB contractors should have (1) adequate staffing level; (2) a good track record for completion on budget; and (3) ability in financial management and quality control. Lam *et al.* (2008) conducted multiple regression analysis to identify the determinants of successful DB projects in Hong Kong. The underlying factors relating to the competence of DB contractors include: (1) project

management skills; (2) construction experience and capabilities; (3) design experience and capabilities; (4) technical skill in construction; and (5) technical skills in design.

Various competences have been stressed by different researchers. A summary of these suggested competences is presented in Table 1.

Table 1 Summary of required competences of DB contractors

Authors	Competences description of DB contractors
Cheng (1995)	The contractor possesses a thorough understanding of buildability and can develop a good design with appropriate construction methods
Songer and Molenaar (1997)	The contractor should have the design-build experience
Mo and Ng (1997)	The contractor should have the design-build experience
Molenaar and Songer (1998)	The contractor has experience with similar types of projects
Pearson and Skues (1999)	The contractor should be experienced in design-build and familiar with local industry, laws and regulations
Leung (1999)	The contractor should be familiar with the local construction industry and have the experience in design-build concept
Hemlin (1999)	The contractor should have strong design management expertise and project management capability for DB projects
Chan <i>et al.</i> (2001a)	The contractor has building techniques and materials to speed up building process; input building knowledge in design development; good project management capability for DB project; and thorough understanding of the design process.
Beard <i>et al.</i> (2001)	The design-builder should have the financial and management capabilities to accept the risks and undertake the responsibilities
Ling <i>et al.</i> (2004)	The DB contractor has key personnel's management ability; ability in financial management; health and safety management capability; and technical expertise.
Ling and Liu (2004)	The contractor should have adequate staffing level, a good track record for completion on budget, and ability in financial management and quality control.
Lam <i>et al.</i> (2008)	The contractor should have the project management skills, construction experience and capabilities, design experience and capabilities, technical skill on construction, and technical skills on design.

Research Methods

The key competences are essential to the success of firm business. Companies can determine their future business directions based on the strengths of their competences (Hafeez *et al.* 2002). The research methods employed in this study included: (1) semi-structured face-to-face interviews; and (2) Delphi questionnaire survey. The semi-structured face-to-face interviews with a sample of five individual experts were conducted to identify a list of potential key competences of design-builders in the construction market of China, and subsequently two rounds of Delphi questionnaire survey were undertaken with another group of twenty individual experts to assess the appropriateness of the proposed competences by rating them against their level of importance based on a ten-point Likert scale.

In the semi-structured face-to-face interviews, all the experts have sufficient DB knowledge, extensive rich hands-on DB experience, and sound strategic management knowledge/experience. They were interviewed to answer the following open-ended questions:

1. *What are the key competences of design-builders in the construction market of the People's Republic of China?*
2. *How the key competence help the design-builders acquire competitive advantages?*

Face-to-face interviews were adopted because of the synchronous communication in time and place. They offer the possibility of dispelling ambiguity because the interviewer will be next to the interviewee as the questions are being answered (Opdenakker, 2006). Another main reason of conducting face-to-face interviews lies in the quality of the data

obtained. Since the DB system has not been commonly used in the People's Republic of China, the capabilities identified in the literature review may not be suitable in the construction market of China. As a result, the mail survey response may suffer from the depth of coverage of this topic in response to an open-ended question. The depth and clarification of responses from face-to-face interviews usually provides data better than those obtained from self-completion methods (Ayidiya and McClendon, 1990). Data and valuable information often rely on the minds, attitudes, feelings or reactions of the respondents. Content analysis was employed to identify the key competences of DB contractors. 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, a total of six key competences of DB contractors were formulated and consolidated for further analysis.

After adopting the content analysis, a Delphi questionnaire survey was conducted. The Delphi method is designed to extract the maximum amount of unbiased information from a panel of experts (Chan *et al.*, 2001b). Even if these collective judgments of experts are made up of subjective opinions, it is considered to be more reliable than individual statements, thus, more objective in its outcomes (Masini 1993). The Delphi method typically involves the selection of suitable experts, development of appropriate questions to be put to them and analysis of their answers (Cabaniss, 2002; Outhred, 2001). The original Delphi procedures have three features: (1) anonymous response; (2) iteration and controlled feedback; and (3) statistical group responses (Adnan and Morledge, 2003).

The features are designed to minimize the biasing effects of dominant individuals, irrelevant communications, and group pressure toward conformity.

The Delphi method used in this research was composed of two rounds with 20 experts. All the experts have sufficient DB experience/knowledge and sound strategic management (most of them take senior management positions in the relevant organizations).. In Round 1 of the Delphi questionnaire survey, the respondents were asked to provide ratings against the levels of importance on each of proposed key competences of design-builders, based on a ten-point Likert scale. Seventeen experts completed the Round 1 of the Delphi questionnaire survey. In Round 2 of the Delphi questionnaire survey, respondents were asked to reconsider the ratings of each competence in the light of the consolidated results from Round 1. Finally, 16 experts completed the round 2 of the Delphi questionnaire survey. The questionnaires in each round are as follows:

Questionnaire1: Please give ratings to the key competences of design-builders according to their importance.

Questionnaire2: Please re-rate the key competences of design-builders in the light of the results from Round 1.

The majority of Delphi studies have used 15-20 respondents (Ludwig, 2001). Moreover, with a homogeneous group of experts, good results can be obtained even with a panel as small as 10-15 individuals (Ziglio, 1996). Therefore, the opinions solicited from the 16

experts in the second round of the Delphi questionnaire survey are considered adequate to provide reliable results.

Analysis of Semi-structured Face-to-face Interviews

Although many studies have identified a variety of design-builders' competencies (some of which have been highlighted in Table 1), given the unique situation of the DB markets around the world, the key competences of design-builders in China will probably be different from those identified in other locations. To identify the specific key competences of design-builders in China, a thorough investigation with interviewees who satisfy the following selection criteria is considered necessary:

- (1) The expert should have sufficient DB experience;
- (2) The expert should have extensive DB knowledge;
- (3) The expert should have sound knowledge of strategic management or have taken senior management position in his or her organization.

Twelve potential experts were identified to have met all the selection criteria. Invitations through emails were sent to these experts to explore their availability to participate in the face-to-face interviews. The invitation email was supported with materials including the research background, the proposed interview questions, the identified capabilities of design-builders (shown in Table 1), and the introduction of sustainable competitive advantages. These materials provide them a clear understanding of the purpose of the study and the extent of participation to be expected. Finally, five experts agreed to participate in the face-to-face interviews.

The five interviewees selected are leading industrial practitioners in the DB fields. Table 2 shows that all of them have rich hands-on experiences in the DB market, hold senior management positions in their organizations and have been involved in the research activities in DB.

Table 2 Background information of the interviewees' information

	Affiliation	Job position	Years of DB experience	Research experience in DB
Expert A	Construction Department in State Government	Deputy Director	12	Yes
Expert B	Top University in China	Head of the Institution	18	Yes
Expert C	Large Private Project Management Firm	Head of Department	9	Yes
Expert D	Large Private Real Estate Developer	Deputy Manager	7	Yes
Expert E	Large-scale State-owned Construction Company	Deputy Chief Engineer	10	Yes

The interviews were conducted in a semi-structured manner. The semi-structured interview is a technique used to collect qualitative data by setting up a situation (the interview) that enables an interviewee to express their opinions on a particular subject. Open-ended questions were used to understand the interviewees' point of view (What are the key competences of design-builders in China? Why do you think they are important?)

After conducting the semi-structured face-to-face interviews, content analysis was used to identify the key competences of DB contractors in China. Weber (1990) stated that content analysis could help classify textual material, reducing it to more relevant,

manageable bits of data. Fellows and Liu (2008) stated that content analysis is frequently adopted 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. The first step to conduct content analysis is to identify the materials to be analysed. The second step is to determine the form of content analysis to be used, which includes qualitative or quantitative. The choice is dependent on the nature of the research project. The choice of categories will also depend on the issues to be addressed in the research if they are known. In qualitative content analysis, emphasis is on determining the meaning of the data (i.e. grouping data into categories). Quantitative content analysis extends the approach of the qualitative form to generate numerical values of the categorized data (frequencies, ratings, ranking, etc) which may be subject to statistical analyses. Comparisons can be made and hierarchies of categories can be examined (Fellows and Liu, 2008). The process in conducting the content analysis at this research stage was that all the key points and main ideas of each interview verbatim transcript were first marked down. Then, similar main points and ideas were assembled and different main themes were finally crystallized from the analysed interview transcripts. After the analysis, a total of six main themes of the key competences of design-builders were categorized, including: (1) experience with similar DB projects; (2) capability of corporate management; (3) combination of building techniques and design expertise; (4) financial capability for DB projects; (5) enterprise qualification and scale; and (6) credit records and reputation in the industry. Finally, the identified key competences were verified and validated by the interviewees. Table 3 shows the six consolidated key competences of design-builders as proposed by the five interviewees.

Table 3 Summary of key competences of DB contractors in China

Perceived competences of DB contractors in China	Expert A	Expert B	Expert C	Expert D	Expert E
1. Experience with similar DB projects	√	√	√	√	√
2. Reputation and credit record in the industry	√	√		√	
3. Level of enterprise qualification and scale	√				
4. Skills of building techniques and design expertise	√	√			√
5. Financial capability for the DB projects	√	√	√		√
6. The ability of corporate management			√	√	√

Two Rounds of Delphi Questionnaire: Results and Analysis

Selection of expert panel

One of the most important considerations when carrying out a Delphi study is the identification and selection of potential members to constitute the panel of experts (Ludwing, 2001; Stone and Busby, 1996). The selection of members or panelists is important because the validity of the study is directly related to this selection process. In this Delphi survey, the researchers attempted to identify panelists who meet all the following selection criteria:

- (1) Having sufficient working experience or knowledge in the DB field;
- (2) Working in relevant organizations in the construction industry;
- (3) Having sound knowledge and understanding of strategic management.

Finally, 20 experts meeting the selection requirements agreed to participate in the Delphi survey. A list of the panel members and their affiliations are shown in Table 4.

Table 4 List of the panel of experts for the Delphi study

Type of firm / department	Number
Real estate developer	1
Government department	3
Design consultant company	3
Project management company	3
University	4
Construction company	6
Total	20

The selected experts represent a wide spectrum of construction professionals in the PRC and provide a balanced view for the Delphi study. Most of the experts have sufficient experience and expertise in DB projects; Table 5 shows the respondent classifications by years working in construction industry and in DB field.

Table 5 Respondent classifications by years working in construction industry and DB field

Years	Working in construction industry	Working in design-build field
0-5	5%	15%
5-10	30%	50%
10-20	30%	30%
20+	35%	5%
Average (Years)	15	9

All the experts have sound knowledge in the strategic management. Furthermore, most of the experts hold management positions in their organizations. Table 6 shows the respondents' job positions/titles.

Table 6 The job positions of the panel experts

Job position	Number
Chief engineer	1
Deputy chief engineer	2
Deputy general manager	2
Project manager	3
General director	1
Project management director	1
Academic	2
Engineer	2
Project management consultant	2
Director of research institute	2
Deputy division chief in government	2
Total	20

The sufficient working experience, sound knowledge in strategic management, and relevant organizations of the selected experts ensure the validity of this Delphi research study.

Round 1 of the Delphi questionnaire survey: Ratings obtained from the experts

In the first round of the Delphi questionnaire survey, the panel experts were requested to assess the importance of each of the six short-listed competences of DB contractors. A 10-point Likert Scale was used. Although the 1-10 ordinal scale is not as frequently used as the 1-7 or 1-5 scale system in Delphi study, it is much more familiar to the Chinese construction experts. If a score is lower than 6 points, it is commonly regarded as failing to pass the threshold of importance evaluation. Therefore, in this research, a mean score of 6 becomes a cut-off point and only the competence whose mean score is 6.0 points or above will be re-evaluated in the next round. Finally, 17 experts completed the questionnaire in late April 2008.

A statistical analysis was performed on the 17 questionnaires received in which the mean ratings for the identified six competences of DB contractors were computed (Table 7). To measure the degree of agreement between the panel members on the ordered list of the six key competences, the Kendall's Coefficient of Concordance (W) was calculated with the aid of the SPSS software. The Kendall's Coefficient of Concordance indicates the degree of agreement between the panel members on the ordered list by mean ranks by taking into account the variations between the rankings (Doke and Swanson, 1995). Table 7 also shows that Kendall's Coefficient of Concordance for the rankings of the six competences of DB contractors was 0.244, which was statistically significant at 1% significance level. The null hypothesis that the respondent's ratings within the group are unrelated to each other would have to be rejected. Therefore, it can be concluded that a significant amount of agreement among the respondents within the group of panel experts is found.

Table 7 Results of Round 1 of the Delphi questionnaire survey: key competences of DB contractors

The key competences of the DB contractors	Mean	Rank
Experience with similar design-build projects	9.12	1
The capability of corporate management	8.12	2
Construction and design techniques	7.94	3
Financial capability for the DB project	7.76	4
Enterprise qualification and scale	7.71	5
Reputation and credit record in the industry	7.59	6

Notes :

Number (n) = 17.

Kendall's Coefficient of Concordance (W) = 0.244

Level of significance = 0.001

Table 8 shows the correlation matrix for the data set. It reveals that the six contractor's competences are not highly correlated with each other at 5% significance level (most of them are even insignificantly correlated with each other). In addition, it is unlikely to have any multiplier effect between them. This provides an adequate basis for proceeding to the next round of Delphi survey on these competences. Finally, all six competences were included in the second round of the Delphi survey to obtain the final key competences.

Table 8 Correlations matrix among the six competences of DB contractors

	Experience	Managemen t	Techniques	Financial	Qualificatio n	Reputation
Experience	1	-.119	-.055	-.106	.524*	.139
Management		1	.232	.629**	.115	.532*
Techniques			1	.243	-.015	-.101
Financial				1	.170	.522*
Qualification					1	.163
Reputation						1

* Correlation is significant at the 5% level (2-tailed).

** Correlation is significant at the 1% level (2-tailed).

Round 2 Delphi questionnaire: Re-assessing the Ratings

In Round 2 of the Delphi survey, the experts were asked to re-assess their ratings in the light of the consolidated results obtained in Round 1. The round 2 of the Delphi questionnaires was distributed to the same group of panel experts by email in late April 2008. Finally, 16 experts completed the questionnaire in late May 2008.

Most experts had reconsidered their ratings provided in the previous round and had made adjustments to their ratings. However, Table 9 shows that the rankings of all competences

remain unchanged when compared with the consolidated results in Round 1. The Kendall's Coefficient of Concordance (W) for the rankings of these variables is also provided in Table 9. The increased value of Kendall's Coefficient of Concordance means that the agreement among the panel experts has improved.

Table 9 Result of Round 2 of Delphi questionnaire survey—key competences of DB contractors

The key competences of the DB contractors	Mean	Rank
Experience with similar design-build projects	9.21	1
The capability of corporate management	8.28	2
Building techniques and design expertise	8.16	3
Financial capability for the project	7.97	4
Enterprise qualification and scale	7.75	5
Reputation and credit record in the industry	7.47	6

Notes :

Number (n) =16.

Kendall's Coefficient of Concordance (W) = 0.301

Level of significance = 0.000

The correlation matrix as indicated in Table 10 manifests that the six key competences are not highly correlated with each other at 5% significance level (all of them are insignificantly correlated with each other). In addition, it is unlikely to have any multiplier effect between them. Finally, the six competences are adopted as the key indicators for the DB contractors' competences.

Table 10 Correlations matrix among the six key competences of DB contractors

	Experience	Manageme nt	Techniques	Financial	Qualificatio n	Reputation
Experience	1	-.309	-.052	-.273	.329	-.139
Management		1	.382	.295	-.161	-.046
Techniques			1	-.296	-.221	-.299
Financial				1	.029	.146
Qualification					1	.085
Reputation						1

* Correlation is significant at the 5% level (2-tailed).

** Correlation is significant at the 1% level (2-tailed).

Discussions on key competences of DB contractors

The final outcome of this paper was the identification of six key competences of design-builders in the construction market of the People's Republic of China. In order to ensure the success of DB projects and to gain competitive advantages, design-builders should strive to acquire DB experiences, corporate management ability, and DB related skills on both design and construction. It should be added that the Delphi method by its inherent nature serves as a self-validating mechanism because individual experts are given chances to re-assess their scores with reference to the consolidated mean scores as assessed by other experts. By using the Delphi method, the maximum amount of unbiased and objective information can be obtained from the panel of experts.

Design-build experience

The design-build experience is regarded as the most important competence for DB contractors. Many researchers (Song and Molenaar, 1997 ; Molenaar and Songer, 1998; Mo and Ng, 1997; Pearson and Skues, 1999; Leung, 1999) advocated that DB projects should be delivered by experienced DB contractors. The DB experience is undoubtedly a source of competitive advantage in the DB market. This is because, firstly, the DB experience is valuable. As DB contractors assume total responsibility for a DB project, they should possess the ability to combine the design and construction functions and

coordinate the various building professionals. The experience with similar DB projects is undoubtedly a direct approach to obtain and demonstrate such abilities. Secondly, the DB experience is rare. This is because the development of DB system is still in its infancy stage in China; and the majority of general contractors still remain unfamiliar with this alternative system. As a result, the contractor's DB experience is, in particular, highly valued by the clients in China. Finally, such DB experience is imperfectly imitable. DB experience is developed through learning-by-doing, and accumulated and refined through practice. It is usually poorly organized, informal and relatively inaccessible. It is hard for competitors to accumulate or develop similar experience of their own.

Corporate management ability

The capability of corporate management was ranked as the second most important key competence of DB contractors. Although many empirical studies focus on the design-builder's project management skills, which contribute to the success of DB projects (Chan *et al.*, 2001a; Ling *et al.*, 2001; Ling and Liu, 2004; Lam *et al.*, 2008), the panel experts in China regard the capability of corporate management as a more important criterion. This is reasonable when considering the situation of the PRC construction industry. The construction industry has become a pillar industry in the national economy; however it has a very competitive market structure. According to *Engineering News Report* and *Construction Times* (2006), the domestic turnover of the top ten Chinese contractors was \$40.323 billion, which only made up about 10 percent of the total output of the construction industry. According to the concept of concentration ratio (CR), which

provides useful information on the degree and nature of market competition (Ratnayake, 1999), the Chinese construction industry has a very competitive market structure. In 2006, there were over 60,000 construction firms competing in the construction market. The low market concentration and the large number of companies lead to fierce competition and low profitability in the construction industry. Therefore, the high ranking of the corporate management ability implies that DB contractors should establish their competitive strength in the construction market and maintain a good operating condition.

Construction and design techniques

Technological strength and innovation can contribute to the growth in market share through the provisions of new or improved products and services and the reduction in construction costs (Slaughter, 1998). The execution of the design-build system is quite different from the traditional way. It requires integration of design and construction works. With fully combination of design and construction functions, design-builders can provide better performance of the projects and add value to the owners.

Konchar and Sanvido (1998)'s empirical research indicates that the delivery speed of DB is faster than that of construction management and traditional design-bid-build system in the United States of American. This is mainly because, firstly, DB system encourages the overlapping of design and construction process, which reduces the delivery schedule. Secondly, the buildability of the design work will be greatly improved due to the early input of construction knowledge to the design process and the close communication

among project participants (Songer and Molenaar, 1997). However, only the contractors with sophisticated skills of both design and construction can fully integrate these two functions, improve the buildability of design work, and successfully speed up the project process. In the DB market of China, considering that most of the design-builders are having general contractor background, the design expertise or design management skill is therefore highlighted as an imperative capability.

Financial capability

In the Chinese construction industry, there is a serious lack of financial resources and channels to most construction companies (Chen, 1998). DB projects, however, usually require large-scale capital for design-builders because most of the DB contracts are awarded on a lump-sum basis. In DB projects, most of the construction works start before the total completion of the shop drawings. It causes greater fluctuation in the labor force and material supply, and thus creates more risks (Ernzen and Schexnayder, 2000). Moreover, the DB system is widely applied in large and complex public projects in China, which are naturally more capital intensive. The ability to acquire financing is, therefore, one major capability that needs to be developed (Cheah *et al.*, 2007).

DB contractors also have to spend a large sum of money and resources for the higher-cost bidding (Yan, 2001). DB projects offer better buildability of the design work. However, it requires clear understanding of client's requirements, early involvement of construction experts in the design development, and close corporations between various professionals

(Cheng, 1995; Arditi, *et al.*, 2002; Yang, *et al.*, 2003; Zin, *et al.*, 2004). As a result, the cost of preparing for design proposals in DB projects will be much higher. In addition, the cost estimation for a DB project is very difficult because the design documents are often preliminary and may change over the life cycle of the project. Only the bigger companies with diverse skills and resources can set up the estimation/bidding system for the DB contract and afford the high bidding cost. Therefore, the competence to acquire financing from banks or other financial institutions helps the design-builders establish greater competitive advantage over the competitors.

Enterprise qualification and reputation

The *PRC Construction Law* classifies construction enterprises into different grades of organizations, depending on their registered capital, specialized technical personnel, track records and so on. A construction company can only engage in construction activities within the permitted scope specified in its qualification certificate. According to Article 5 of *Regulation on Construction Engineering Enterprises Qualification*, classifications for construction engineering enterprises include general contracting, specialty contracting, and labor service subcontracting. The specific grades for general contracting include: Special Grade, Grade 1, Grade 2, and Grade 3. Although no specific qualifications or licensing regulations have been legislated for the DB business, most of the clients still require the DB contractors to possess the highest grade of classifications as required in the general contracting. Therefore, the requirements of enterprise qualification constitute barriers to entry into the DB market for potential design-builders.

Corporate reputation or credit record is an invaluable intangible asset. It may even produce long-term competitive advantage and shareholder value (Fombrun, 1996; Gray and Balmer, 1998). Corporate reputation can not only impede rivalry but also result in price premiums for projects and create additional leverage in negotiations with suppliers and creditors. Similar to the DB experience, the credit record and reputation of DB contractors can directly reflect their competences in the construction field. For example, if a DB contractor wins the Luban Award of Chinese Construction Project, which is a top award for a general contractor in China, it will be easier to convince the owners that it is capable of completing the task well. In the construction market of China, although many contractors remain inexperienced with DB system, most of the stronger or larger scale firms intend to explore the DB market because DB projects generally offer higher profit margins. In this situation, their track records or reputation in the construction field will, in particular, be an important source for them to establish the competitive advantages in the DB market.

Significance, limitation of the study and future work

The key competences identified generally confirm the capabilities obtained from the literature review. These key competences not only contribute to the success of DB projects, but they also function as sources of competitive advantages. Not all the capabilities constitute the key competences. Only those valuable, rare, and imperfectly imitable ones can be regarded as the key competences and enable design-builders to

acquire competitive edges. The research findings, therefore, furnish the design-builders with perspectives to establish their competitive advantages in the DB market.

However, it is worth noting that some of the identified competences are still broad and vague concepts (such as the corporate management ability)..Different assessors may have their own semantic interpretation on each competence. Thus it is desirable to identify suitable quantitative interpretations/indicators for each competence and provides objective evaluation results based on quantitative evidence in the future. In addition, similar to any other opinion-based research study, this research study suffer from subjectivity, bias, imprecise definition, and human inability to process complex information. However, the effects of these limitations can be further reduced by taking a larger sample size in the face-to-face interviews and the Delphi questionnaire survey.

Further research could be conducted to facilitate the selection of appropriate DB contractors in the light of the research findings of this study. Contractor selection is one of the main decisions made by the clients, for all types of procurement arrangement (Cheng and Li, 2004). Hatush and skitmore (1997) stated that there are five common process elements for the contractor selection. These include project packaging, invitation, pre-qualification, short-listing and bid evaluation. In DB projects, pre-qualification is a common practice to assess the capabilities of contractors to carry out a DB contract successfully. However, a common set of selection criteria is yet to be identified (Pongpeng and Liston, 2003). The key competences of design-builders identified in this research help fill up this knowledge gap. With suitable indicators for each key

competence along with an appropriate scoring system, a pre-qualification model for DB contractors can be established in the future.

Conclusions

Six key competences of design-builders in the construction industry of the People's Republic of China have been identified in this study through a comprehensive literature review, five semi-structured face-to-face interviews, and a two-round Delphi survey. The findings indicate that competent design-builders should possess relevant DB experience, corporate management ability, financial capability for DB projects, skills to integrate design and construction functions, required enterprise qualification and sound reputation to acquire the competitive advantages in the DB market. The results confirm the specific conditions of the DB market in the People's Republic of China.

The research findings of this study provide some practical implications, especially for the potential DB contractors. For large-scale contractors, the DB experience is the main barrier to entry into the DB market. Therefore, the collaboration with experienced DB contractors is essential to the success of their first project if in-house competencies are not available. For most of the medium-scale to small-scale companies, it is more appropriate for them to become the specialty subcontractors to enter into the DB market. Another important suggestion, particularly for DB clients, is that when selecting the appropriate DB contractors, they should pay more attention to the qualifications of

potential contractors 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 key competences of design-builders would vary in different conditions of DB markets. For instance, in the Chinese construction market, because of the lack of mature credit system and the heavy intervention from the government, the qualification certificate and the reputation are regarded as the key competences of the design-builders. Further research should, therefore, be conducted in other geographical locations to find out their similarities and differences for international comparisons. Furthermore, it should be noted that the key competences and their rankings will likely change over time as the DB market matures in China.

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