

Potential Obstacles to Successful Implementation of Public-Private Partnerships in Beijing and the Hong Kong Special Administrative Region

Albert P. C. Chan¹; Patrick T. I. Lam²; Daniel W. M. Chan, M.ASCE³; Esther Cheung⁴; and Yongjian Ke⁵

Abstract: Public-private partnership (PPP) has been practiced for quite some time around the world and there are numerous infrastructure, construction, and building projects which are employing the concepts. Unfortunately, not all of these PPP projects are equally successful and some of these projects have been exposed to formidable obstacles. The need to identify potential obstacles for PPP projects is therefore becoming an important issue for both research and practice. Despite the amount of interest vested in PPP, it is normally the advantages of PPP that are touched on rather than the potential obstacles. Both Beijing and the Hong Kong Special Administrative Region (referred to as Hong Kong from here onwards) have been keen to introduce more PPP projects. This paper presents part of the findings of an empirical questionnaire survey in relation to the prevailing barriers to PPP success conducted in these two administrative systems. It was anticipated that the obstacles would be similar for these jurisdictions. Respondents were asked to rate the level of severity of thirteen potential obstacles toward PPP projects identified from a literature review. The top three obstacles rated by the Beijing respondents were found to be “lengthy delays in negotiation,” “lack of experience and appropriate skills,” and “lengthy delays because of political debate.” Similarly the first and third obstacles ranked by the Beijing respondents were also ranked within top three by the Hong Kong respondents, together with “very few schemes have actually reached the contract stage (aborted before contract).” It was also discerned that “less employment positions,” “reduce the project accountability,” and “high project costs” were all ranked bottom by both of the Beijing and Hong Kong respondents. Moreover, the results obtained in the United Kingdom reported in other studies also shown consistency with those of Beijing and Hong Kong. Therefore the research hypothesis was proved to be true. Although the importance of the obstacles was similar it was realized that the scores obtained in the United Kingdom survey were much lower. This observation showed that the British respondents were less threatened by the obstacles, probably due to the fact that they are much more experienced and confident in undertaking PPP projects compared to Beijing and Hong Kong. Further analysis of the data reflected that the responses within each administrative system were consistent as revealed from the Kendall’s concordance analysis. Although the Spearman rank correlation test indicated that there was no significant disagreement on the rankings of obstacles between respondents of the two administrative systems, considerable difference was detected by the independent two-sample t-test in the mean value of their responses between the two administrative systems for the two obstacles lack of experience and appropriate skills and lengthy delays in negotiation. In Beijing, respondents felt that lack of experience and appropriate skills were highly important ranking it second place, but in Hong Kong this obstacle was ranked eighth, showing their confidence in experience and skills. For lengthy delays in negotiation, although the ranking between Beijing and Hong Kong was similar the difference in score showed a large variation. This represents a difference in tendering procedures between the two administrative regions. Triangulation with real cases largely supports the survey findings.

DOI: 10.1061/(ASCE)0742-597X(2010)26:1(30)

CE Database subject headings: China; Hong Kong; Infrastructure; Partnerships; Private sectors; Procurement.

Author keywords: Beijing; Hong Kong; Infrastructure; Partnerships; Private sector; Procurement.

¹Professor and Associate Head, Dept. of Building and Real Estate, The Hong Kong Polytechnic Univ., Hung Hom, Kowloon, Hong Kong Special Administrative Region, China. E-mail: bsachan@polyu.edu.hk

²Associate Professor, Dept. of Building and Real Estate, The Hong Kong Polytechnic Univ., Hung Hom, Kowloon, Hong Kong Special Administrative Region, China. E-mail: bsplam@polyu.edu.hk

³Assistant Professor, Dept. of Building and Real Estate, The Hong Kong Polytechnic Univ., Hung Hom, Kowloon, Hong Kong Special Administrative Region, China. E-mail: bsdchan@polyu.edu.hk

⁴Research Associate, Dept. of Building and Real Estate, The Hong Kong Polytechnic Univ., Hung Hom, Kowloon, Hong Kong Special Ad-

ministrative Region, China (corresponding author). E-mail: bsesther@polyu.edu.hk

⁵Ph.D. Candidate, Dept. of Construction Management, Tsinghua Univ., Beijing 100084, China. E-mail: kyj05@mails.tsinghua.edu.cn

Note. This manuscript was submitted on April 23, 2008; approved on April 21, 2009; published online on December 15, 2009. Discussion period open until June 1, 2010; separate discussions must be submitted for individual papers. This paper is part of the *Journal of Management in Engineering*, Vol. 26, No. 1, January 1, 2010. ©ASCE, ISSN 0742-597X/2010/1-30-40/\$25.00.

Introduction

Public-private partnership (PPP) projects are collaborations in which the public and private sectors both bring their complementary skills to a project, with different levels of involvement and responsibility, for the sake of providing public services more efficiently (Efficiency Unit 2003). The PPP form of procurement is recognized as an effective way of delivering value-for-money in public infrastructure or services. It seeks to combine the advantages of competitive tendering and flexible negotiation, and to allocate risk on an agreed basis between the public and private sectors (Li et al. 2005a). It is essential for the public client and the private bidders to evaluate all of the potential obstacles throughout the whole project life. Recognition of obstacles at an early stage allows detection of obstacles and enables the PPP stakeholders to avoid them and take mitigation measures. Echoing the risk allocation principle, the cardinal rule is that obstacles associated with the implementation and delivery of services should be dealt with by the party best able to manage them in a cost effective manner.

Although Hong Kong is part of China, under the “one country, two systems” policy, the practice and experience of conducting PPP projects in different cities within China can be quite different. Hong Kong has been governed by the British for a long duration, and during this time the western practices of running projects proactively have been assimilated by the local government. On the other hand, a typical Chinese city like Beijing has always adopted a more conservative Asian approach to procuring projects. One major similarity between the two administrative systems is that both have had a strong interest in procuring more public projects using the PPP model. Clearly, more empirical studies are needed to examine the potential obstacles when considering engagement in a PPP project, particularly in China because of its unique legal and economical system (Shen and Wu 2005).

The findings presented in this paper examine specifically the potential obstacles for adopting PPP instead of traditional procurement system in both Beijing and Hong Kong. This study forms part of a research study looking at developing a best practice framework for PPPs in Hong Kong (Chan et al. 2007a). The specific objectives of this research include:

1. Identify the benefits, difficulties, and critical success factors of PPP.
2. Measure the effectiveness of PPP against other procurement methods.
3. Identify representative case studies from other countries for analysis to identify their approach to success/failure.
4. Identify previous projects in Hong Kong that used a similar approach to PPP and to analyze their implementation successfulness.
5. Investigate the best conditions in terms of project nature, project complexity, project types and project scales under which the use of PPP is the most appropriate.
6. Evaluate the findings collected to determine a best practice framework for implementing PPP in Hong Kong.

Literature Review of PPP Obstacles

There is no one best procurement method which can be applied to deliver all types of projects and PPP is no exception. Therefore, a comprehensive literature review was carried out to identify the potential obstacles of PPP. As shown in Table 1, a total of four-

teen obstacles were elicited from the literature review. Some of these obstacles share similarities, hence six key obstacle groups were determined and the obstacles were categorized among these groups as follows:

1. Misallocation of risks.
 - High risk.
2. Private sector failure.
 - lack of innovations in design and
 - lack of suitable skills and experience.
3. High transaction costs and lengthy lead time.
 - High transaction costs;
 - High bidding costs;
 - Lengthy bidding and negotiation process; and
 - Lack of competition.
4. Political/social obstacles.
 - Lack of flexibility;
 - Public opposition;
 - Fewer employment opportunities; and
 - High service charge to the end users.
5. Lack of well-established legal framework.
 - Absence of well-established legal framework and
 - Indirect control of standards.
6. Nonconductive financial market.
 - Difficulties in seeking financial partners.

Misallocation of Risks

The impact of risks to project objectives in completing a PPP project is usually significant, and these risks arise from multiple sources including the political, social, technical, economic, and environmental factors, due mainly to the complexity and nature of the disciplines, public agencies, and stakeholders involved. Both the private and public sectors need to have a better understanding of these risks in order to achieve an equitable risk allocation and enable the project to generate better outcomes (Chan et al. 2006; Environment, Transport and Works Bureau 2004; Gunnigan and Eaton 2006; Koppenjan 2005; Li 2003; Merna and Owen 1998; Mustafa 1999; Ng and Wong 2006; Satpathy and Das 2007; Xenidis and Angelides 2005; Zhang 2001; Zhang and AbouRisk 2006; Zayed and Chang 2002; Sun et al. 2008). In fact, a fair and reasonable allocation of various risks is vital to PPP success. If risks are inequitably or wrongly allocated beyond the capacity of the parties concerned, PPP projects would fail (e.g., demand risk resulting from town planning falling on private consortia).

As seen in the London Underground case, the public entity retains interface risk when the modernization and maintenance of the infrastructure and trains were contracted to three separate private consortia (Higton 2005). Three derailments were reported in 2004 leading to disruption fines of £40 million against the operator Tube Lines and aggregate fines of £32 million for failures in meeting benchmarks for performance (Rukuts 2004). A wrong risk allocation could easily lead to the failure of a PPP project. If the risks are wrongly allocated then the parties responsible for those risks may not be in capable hands to take the necessary mitigation measures. In the occurrence of an unexpected incident or failure, the poorly assigned party will be unable to resolve the problem leading to possible downfall to the project.

Private Sector Failure

PPP projects may fall apart due to failure on the part of the private sector participants. In contracting out the PPP projects, the

Table 1. Obstacles of PPP from Published Literature

Literature	Potential obstacles of PPP														Total number of obstacles identified from each publication
	Misallocation of risks	Private sector failure		High transaction costs and lengthy lead time				Political/social obstacles			Lack of well-established legal framework		Nonconductive financial market		
	High risk	Lack of innovations in design	Lack of suitable skills and experience	High transaction costs	High bidding costs	Lengthy bidding and negotiation process	Lack of competition	Lack of flexibility	Public opposition	Fewer employment opportunities	High service charge to the end users	Absence of well-established legal framework	Indirect control of standards	Difficulties in seeking financial partners	
Corbett and Smith (2006)		x	x	x	x		x	x							6
Chan et al. (2006)	x		x		x	x									4
Environment, Transport and Works Bureau (2004)	x			x	x	x							x		5
El-Gohary et al. (2006)									x						1
Zhang (2001)	x		x	x	x	x							x	x	7
Li (2003)	x		x	x	x	x				x	x				7
Xenidis and Angelides (2005)	x		x		x		x								4
Mustafa (1999)	x				x	x		x							4
Merna and Owen (1998)	x		x	x		x									4
Grimsey and Lewis (2004)			x	x		x		x	x		x	x		x	8
Gunnigan and Eaton (2006)	x	x	x												3
Zhang and AbouRisk (2006)	x			x					x	x					4
Satpathy and Das (2007)	x											x			2
Ng and Wong (2006)	x		x										x		3
Koppenjan (2005)	x		x												2
Li et al. (2005b)			x	x	x	x	x			x	x	x			8
Total number of citations for an obstacle	12	2	11	8	8	8	3	3	3	3	3	3	3	2	72

government should ensure that the parties in the private sector consortium are sufficiently competent and financially capable of taking up the projects. Due to a lack of relevant skills and experience of project partners, PPP projects are more complex to procure and implement (e.g., London Underground). The operating company of the British National Railway after privatization, Rail-track, had allowed the skills and experience in engineering services and infrastructure operation vital to its success to fall into the hands of its suppliers, making it insolvent in 2001, and causing its replacement by the Network Rail (Higton 2005).

High Transaction Costs and Lengthy Lead Time

PPP project arrangements are complex and involve many parties with conflicting objectives and interests. Hence, PPP projects often require extensive expertise input and high costs and take lengthy time in deal negotiation. The high transaction costs and lengthy time may not represent good value to all parties and as a result the deal may not materialize in the beginning or may falter in the end. PPP projects may incur higher transaction costs than those under the conventional public sector procurement. The legal and other advisory fees would be included as lawyers are involved in all stages of a PPP project, as well as the cost of private sector finance, and the price premium for single point responsibility arrangement. The potential high transaction costs may have a negative impact on the objective of securing the best value (Corbett and Smith 2006; Environment, Transport and Works Bureau 2004; Grimsey and Lewis 2004; Li 2003; Li et al. 2005b; Merna and Owen 1998; Zhang 2001; Zhang and AbouRisk 2006; Carrillo et al. 2008). Complex PPP projects require inputs from many parties of different expertise. Therefore, the projects should be economically viable to cover such costs.

One common problem encountered in PPP projects is the high bidding costs, which is owing to increasing project complexity and protracted procurement process. The private sector incurs high bidding costs partly due to the consideration of the client's and their financiers' objectives. Lengthy negotiations and especially the cost of professional services may increase the bidding costs further (Chan et al. 2006; Corbett and Smith 2006; Environment, Transport and Works Bureau 2004; Li 2003; Li et al. 2005b; Mustafa 1999; Xenidis and Angelides 2005; Zhang 2001; Askar and Gab-Allah 2002).

The PPP bidding process is also regarded as lengthy and complicated. For example, bidders are required to prepare tender proposals attached with a bundle of additional materials. Such a process may take 3 to 4 months. Besides, another several lengthy negotiations will be required for the formation of the contract. Clearly, setting up a complicated agreement framework for successful PPP implementation can slow down the bidding process (Chan et al. 2006; Environment, Transport and Works Bureau 2004; Grimsey and Lewis 2004; Li 2003; Li et al. 2005b; Merna and Owen 1998; Mustafa 1999; Zhang 2001).

The London Underground project took a while for the contract negotiation process, it is therefore possible that the preferred bidders were selected too early. Thus the bidders were able to push back a number of risks without necessarily reducing those elements of their price structure that had covered those risks. Development of the technical and procurement strategies, and the tender documentation, had been in progress for over two years (Higton 2005). Two of the maintenance contracts were awarded late due to protracted negotiations (Rukuts 2004).

Political/Social Obstacles

One other reason for failure is the stakeholders' opposition and public opposition. Whether the proposed project is consonant with the interest of the public is important as public opposition can adversely affect the funding for the project from the public sector (El-Gohary et al. 2006; Grimsey and Lewis 2004; Zhang and AbouRisk 2006). PPP in public projects typically incur political and social issues like land resumption, town planning, employment, heritage, and environmental protection. These could result in public opposition, overblown costs, and delays to the projects.

Another common complaint by the public is the high tariff charged for the services provided. More often, the private sector would face political uphill in raising tariff to a level sufficient to cover its costs and earn reasonable profits and returns on investment. The participation of the private sector to provide public service will undoubtedly bring innovations and efficiencies in the operation, but may produce a fear of downsizing in the public sector. To a certain extent, there would be fewer employment opportunities if no regulatory measures were implemented (Li 2003; Li et al. 2005b; Zhang and AbouRisk 2006).

Lack of Well-Established Legal Framework

The introduction of PPP exerts unprecedented pressure on the legal framework as it plays an important role in economic development, regeneration, and mechanism for developing infrastructure. Still, some countries do not have a well-established legal framework for PPP projects and the current legal framework is only supposed to deal with the traditional command and control model. Although PPP involves a great deal of legal structuring and documentation to deal with potential disputes among PPP parties, a "water-tight" legal framework is still lacking (e.g., protection of public interests vs legitimate rights of private sector). Without a well-established legal framework, disputes are inevitable (Grimsey and Lewis 2004; Li et al. 2005b; Satpathy and Das 2007).

Nonconductive Financial Market

Private sector investors bear financial risks in funding of the investment. Seeking financially strong partners in a PPP project is regarded as difficult. In most PPP arrangements, the debt is limited-recourse or non-recourse, where financiers need to bear risks. In fact, most stakeholders are not willing to accept excessive risks. The lack of mature financial engineering techniques on the part of the host countries can also be another problem (Grimsey and Lewis 2004; Zhang 2001). Unattractive financial market (e.g., politically unstable or high interest rate) is often an obstacle to PPP success. Therefore, a conducive financial market is important for the private parties to drive PPP projects.

Previous Research on PPP Obstacles

The obstacles identified from reported literature (as discussed previously in this paper) were compared to those researched by Li (2003). The results in Fig. 1 show that all obstacles identified by literature compliment those sought by Li (2003). Although the authors could have developed their own research questionnaire,

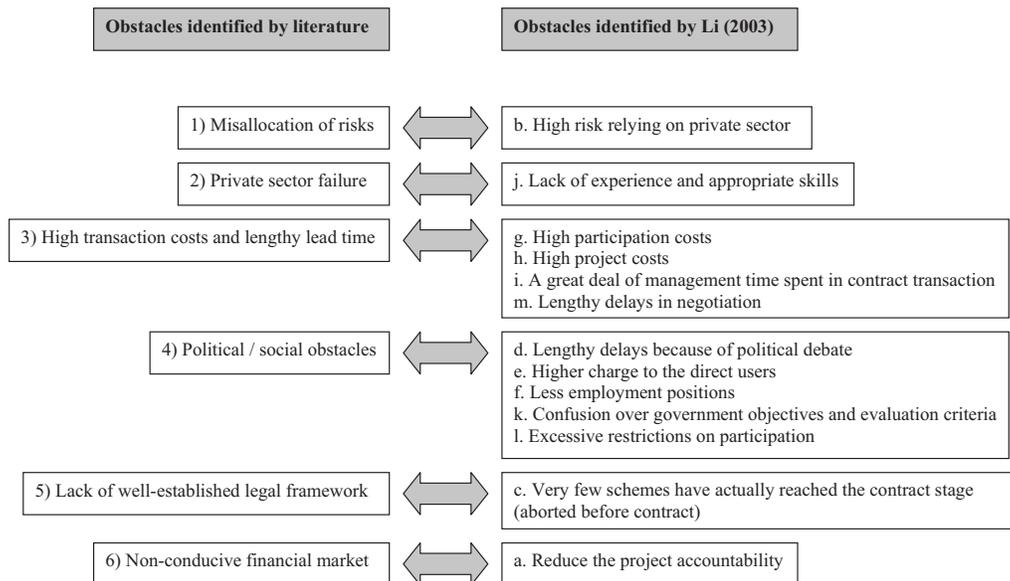


Fig. 1. Summary of obstacles for adopting PPP as identified from literature and by Li (2003)

there were several advantages foreseeable to adopt the survey questionnaire of Li (2003) survey questionnaire rather than designing a new template. First, the value of the questionnaire of Li (2003) has already been recognized by the industry at large. His publications as a result of the research findings derived from the questionnaire are evidence of its worthiness. Second, there would be no added advantage to reinvent the work that has previously done by other researchers. Third by administering the questionnaire of Li (2003) again but in different administrative systems, it would be of interest for comparison purposes in the future. Therefore the questionnaire of Li (2003) was adopted for the survey as presented in this paper with prior permission obtained from the writer, Dr. Li Bing, and his doctoral research supervisor, Professor Akintola Akintoye, who is currently the Head of the School of Built and Natural Environment, University of Central Lancashire, United Kingdom.

Research Methodology

Collection of Research Data

An empirical questionnaire survey was undertaken in both Beijing and Hong Kong from October to December 2007, to compare and contrast the obstacles for adopting PPP in these two similar and yet different administrative systems. It was anticipated that the top obstacles identified would be similar for these jurisdictions. In this study, the target survey respondents of the questionnaire included all industrial practitioners from the public, private, and other sectors. These respondents were requested to rate their degree of agreement against each of the identified obstacles according to a five-point Likert scale (1=least important and 5=most important).

Target respondents were selected based on their direct hands-on involvement in PPP projects. Survey questionnaires were sent to 103 target respondents in Beijing and 95 target respondents in Hong Kong. It was anticipated that some of these target respondents would have colleagues and personal connections who would be knowledgeable in the area of PPP to participate in this research study as well; hence some of the respondents

were dispatched five blank copies of the survey form. A total of 53 completed questionnaires from Beijing and 34 from Hong Kong were returned representing response rates of 52 and 36%, respectively. Although there were a total of 87 responses received, only 80 were valid for any subsequent statistical analyses including 48 from Beijing and 32 from Hong Kong. As shown in Fig. 2, among these respondents just under half were from the private sector, a sixth were from the public sector and over a third was from other organizations (mainly academics and researchers). The survey findings were analyzed using the Statistical Package for Social Science (SPSS). For each questionnaire entry, SPSS would automatically detect unanswered questions by the remaining gaps. As a result the whole entry would not be included in any statistical analysis conducted. Hence the questionnaires suitable for statistical analysis were those where the respondents answered all questions only.

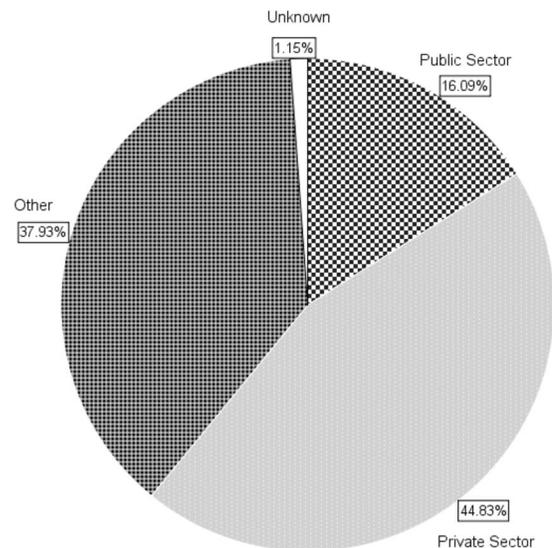


Fig. 2. Background of the questionnaire respondents

The higher response rate in Beijing compared to Hong Kong was anticipated. There have not been that many PPP type projects in Hong Kong hence the number of people involved in PPP type projects would be less. Beijing on the other hand has been involved in many more PPP type projects recently in comparison with Hong Kong. Also, the population size in Beijing is much higher than Hong Kong. Beijing has a booming population size of 17.43 million as recorded in March 2008 (*Wikipedia* 2008a), and although Hong Kong is densely populated for a city of its size, its population is much smaller than Beijing at only 6.96 million at the end of 2007 (Census and Statistics Department 2008).

Tools for Data Analysis

Mean Score Ranking Technique

Chan and Kumaraswamy (1996) adopted the “mean score” (MS) method to establish the relative importance of causes of delay in building construction projects in Hong Kong as suggested by the clients, consultants, and contractors. The data collected from the current questionnaire survey was also analyzed using the same technique, within various groups as categorized according to the origin of the respondents (i.e., Beijing and Hong Kong). The five-point Likert scale (1=least important and 5=most important) as described previously was used to calculate the MS for each obstacle, which was then used to determine its relative ranking in descending order of importance. These rankings made it possible to cross compare the relative importance of the obstacles to the respondents from Beijing and Hong Kong. The MS for each obstacle was computed by the following formula:

$$MS = \frac{\sum(f \times s)}{N}, \quad (1 \leq MS \leq 5) \quad (1)$$

where s =score given to each obstacle by the respondents, ranging from 1 to 5 (1=least important and 5=most important); f =frequency of response to each rating (1 to 5), for each obstacle; and N =total number of responses concerning that obstacle.

Kendall's Concordance Analysis

The survey respondents were based on two groups: Beijing and Hong Kong. Kendall's concordance analysis was conducted to measure the agreement of different respondents on their rankings of obstacles based on mean values within a particular group. If the Kendall's coefficient of concordance (W) carries a predefined significance level of say 0.05, a reasonable degree of consensus among the respondents within the group on the rankings of obstacles was indicated. The W for the obstacles was calculated by the following formula (Siegel and Castellan 1988):

$$W = \frac{\sum_{i=1}^n (\bar{R}_i - \bar{R})^2}{n(n^2 - 1)/12} \quad (2)$$

where n =number of obstacles being ranked; \bar{R}_i =average of the ranks assigned to the i th obstacle; and \bar{R} =average of the ranks assigned across all obstacles.

According to Siegel and Castellan (1988), W is only suitable when the number of attributes is less than or equal to 7. If the number of attributes is greater than 7, chi-square is used as a near approximation instead. The critical value of chi-square is obtained by referring to the table of critical values of chi-square distribution, which can be found in Siegel and Castellan (1988).

Spearman Rank Correlation Test

The level of agreement between the two respondent groups (Beijing and Hong Kong) on their rankings of obstacles was measured by the Spearman rank correlation coefficient (r_s). Again, if r_s was significant at a predetermined significance level of, say 0.05, there is no significant disagreement between the two sets of rankings. The Spearman rank correlation coefficient (r_s) for the obstacles was computed by the following formula [Statistical Package for Social Science (SPSS) 2002]:

$$r_s = 1 - \frac{6\sum d^2}{N(N^2 - 1)} \quad (3)$$

where d =difference in rank of the two groups for the same obstacle and N =total number of responses concerning that obstacle. The analysis procedures described have also been used in other similar research survey studies such as Chan (2000) and Chan et al. (2003).

Independent Two-Sample t -Test

Independent two-sample t -test is used to test for a difference between two independent groups on the means of a continuous variable (SPSS 2002). Several assumptions are made:

1. Two independent random samples have been extracted from each population;
2. The two populations are both normally distributed; and
3. The two populations have a common (equal) variance (if the number of cases in each of the groups is similar, then the equality-of-variance assumption is not so important).

The t -statistic can be defined in the following way (Keller 2005):

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\bar{\mu}_1 - \bar{\mu}_2)}{\sqrt{s_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} \quad (4)$$

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} \quad (5)$$

where n_1 =number of observations for Group 1; n_2 =number of observations for Group 2; \bar{x}_1 =mean of Group 1; \bar{x}_2 =mean of Group 2; $\bar{\mu}_1$ =population mean for Group 1; $\bar{\mu}_2$ =population mean for Group 2; s_1^2 =sample variance for Group 1; and s_2^2 =sample variance for Group 2.

Discussion of Survey Results

The obstacles for adopting PPP were assessed from different perspectives of the Beijing and Hong Kong respondent groups. The means for each administrative system were calculated and ranked in descending order of importance as shown in Table 2. Table 2 also shows those calculations of means by Li (2003) for comparison.

Ranking of PPP Obstacles

The mean values for the obstacles as rated by the Beijing respondents ranged from 2.51 to 4.08. For those rated by respondents in Hong Kong the mean values ranged from 2.79 to 3.82. The variations in responses were 1.57 and 1.03 for Beijing and Hong Kong respondents, respectively. This observation has shown that the variation in responses given by Beijing respondents was much

Table 2. MSs and Rankings for the Obstacles of PPP

	Li (2003)			Beijing and Hong Kong			Beijing			Hong Kong		
	N	Mean	Rank	N	Mean	Rank	N	Mean	Rank	N	Mean	Rank
a. Reduce the project accountability	61	1.90	11	87	2.99	12	53	3.11	12	34	2.79	12
b. High risk relying on private sector	61	2.22	10	87	3.25	10	53	3.36	10	34	3.09	10
c. Very few schemes have actually reached the contract stage (aborted before contract)	61	1.71	13	87	3.51	4	53	3.57	7	34	3.41	3
d. Lengthy delays because of political debate	61	2.48	6	87	3.79	2	53	3.77	3	34	3.82	1
e. Higher charge to the direct users	61	2.33	8	87	3.38	9	53	3.45	9	34	3.26	9
f. Less employment positions	61	1.81	12	87	2.62	13	53	2.51	13	34	2.79	13
g. High participation costs	61	3.53	3	87	3.48	6	53	3.57	6	34	3.35	5
h. High project costs	61	2.43	7	87	3.10	11	53	3.15	11	34	3.03	11
i. A great deal of management time spent in contract transaction	61	3.86	1	82	3.46	8	48	3.58	5	34	3.29	6
j. Lack of experience and appropriate skills	61	2.78	5	86	3.69	3	53	3.94	2	33	3.27	8
k. Confusion over government objectives and evaluation criteria	61	2.81	4	87	3.47	7	53	3.51	8	34	3.41	4
l. Excessive restrictions on participation	61	2.32	9	87	3.49	5	53	3.62	4	34	3.29	7
m. Lengthy delays in negotiation	61	3.68	2	86	3.84	1	53	4.08	1	33	3.45	2

Note: N=number of survey respondents.

larger than those given by Hong Kong respondents. Therefore, Hong Kong respondents rated the obstacles more similarly than their mainland counterparts. On the other hand, Li (2003) conducted the same survey in the United Kingdom, it was found that the mean values obtained ranged from 1.71 to 3.86. The results showed that the British respondents rated these obstacles in general much lower than respondents from Beijing and Hong Kong. It can thus be interpreted that the British respondents found that these obstacles were less of a challenge. This finding is logical as the United Kingdom is much more experienced in delivering PPP projects compared to Beijing and Hong Kong. From the mean calculations of Beijing and Hong Kong it was also observed that the majority (11 out of 13 obstacles) were rated higher by Beijing respondents. These obstacles include:

1. Reduce the project accountability;
2. High risk relying on private sector;
3. Very few schemes have actually reached the contract stage (aborted before contract);
4. Higher charge to the direct users;
5. High participation costs;
6. High project costs;
7. A great deal of management time spent in contract transaction;
8. Lack of experience and appropriate skills;
9. Confusion over government objectives and evaluation criteria;
10. Excessive restrictions on participation; and
11. Lengthy delays in negotiation.

The other two obstacles were rated higher by Hong Kong respondents, including:

1. Lengthy delays because of political debate and
2. Less employment positions.

In Hong Kong, public works projects are often delayed and complicated by the need for public consultation, hence it is not surprising that lengthy delays because of political debate was one of the obstacles ranked high by Hong Kong respondents. This problem is well known for causing projects to be held back. For example, the West Kowloon Cultural District project has been cited as a typical example in Hong Kong where political interference has caused the project to be on hold for many years (Chan et

al. 2007b). Initially there was much political debate within the Legislative Council as to whether this project should proceed as a PPP, especially whether the whole project with an estimated cost of \$25 billion (Wikipedia 2008b) should be handled by one single consortium instead of half a dozen number of consortia each sharing the pie. The local government was also alleged to be unclear of the long-term policy and objectives for this cultural development project, causing much criticism from the general public. Another obstacle that was ranked high by Hong Kong respondents was less employment positions. This factor obviously shows that Hong Kong respondents are more concerned over the employment opportunities and the repercussion that would be on employment terms given private sector's pragmatism on human resources policy. This is probably because Hong Kong respondents are less familiar with the ideas and concepts of PPP projects and are therefore more cautious about the negative consequences associated with them.

The top three obstacles selected by the Beijing respondents included: (1) lengthy delays in negotiation; (2) lack of experience and appropriate skills; and (3) lengthy delays because of political debate. Although a new round of PPP investment tide is emerging in Beijing again, there are some contingent problems of PPP application. Due to the lack of PPP experience and knowledge or, for short-term purposes, some local governments may provide unrealistic or unreasonable guarantees and supports to improve the attraction of the proposed projects, which may even be against the central government's policies, the long-term goals or public interests are undermined (Sachs et al. 2007). However, this adds risk of delay or breach of contract, once the local governments are unable or unwilling to commit. Taking a wastewater plant project in Jiangsu Province, for example, the company began the contract negotiation at the end of 2001, signed a framework Concession Agreement in July 2002, but only officially signed the Build Operate Transfer (BOT) Concession Agreement in August 2003 (Wang 2006). During the project development process, the issuance of "Notice on Abolishing Fixed Return of BOT Projects" in December 2002 by the State Development and Reform Commission prolonged the contract negotiation as the expected return should then be renegotiated. The change of the local government and the chief-in-charge also prolonged the negotiation as the

original government guarantees on debt were cancelled. In light of the prevailing circumstance, respondents in Beijing therefore scored these three items higher.

The first and third obstacles ranked by the Beijing respondents were also ranked by the Hong Kong respondents within top three rankings. The first obstacle ranked by the Beijing respondents was ranked second by respondents in Hong Kong. As discussed previously both groups of respondents opined that lengthy delays in negotiation was an important obstacle. This problem has also been demonstrated in a recent highly profiled case: the Hong Kong-Zhuhai-Macau Bridge. It was first proposed in the eighties by a private party hence has always been expected to be procured by the PPP model. Only recently have the three local governments decided that the project would be more appropriate to be procured by more traditional methods. But this decision took over two decades to be reached (Oriental Newspaper 2008). There were two main reasons that confirmed the governments' decisions to pay for the project themselves. First the project would be delivered faster. According to Chen (2008) the project would be completed 2 years earlier than the PPP method. Second, the governments would be able to keep control of the tolls (Ng 2008). Similarly the respondents from Li's (2003) survey conducted in the United Kingdom also rated this obstacle highly at second place. The second obstacle ranked by the Beijing respondents was ranked eighth in the Hong Kong ranking, and fifth in the survey of Li (2003). This occurrence shows that Beijing respondents perceived that there was a lack of experience and appropriate skills whereas the Hong Kong and British respondents were much more comfortable about the experience and skills available. Besides the unrealistic or unreasonable guarantees of some local governments, some investors may also sign unfair contracts and generate huge profits from PPP projects because of the limited PPP experience and knowledge of the local governments. This would indeed hamper the long-term security for PPP investment in China (Sachs et al. 2007). Without doubt the British are much more experienced and hence more confident in launching PPP projects. Although Hong Kong may not have gained abundant experience in PPP projects, it is an international city which has attracted many leading overseas companies to base their offices. Hence Hong Kong is fully equipped with experts and resources from the private sector. The third obstacle as ranked by the Beijing respondents was ranked first by Hong Kong respondents, and sixth in the survey of Li (2003). Immediately it is obvious that the British are not as concerned about problems arising from political debate compared to the Beijing and Hong Kong respondents. As discussed previously, Hong Kong respondents felt very strongly about lengthy delays in negotiation. This obstacle was also found to be important in Beijing. The third obstacle as ranked by Hong Kong respondents was very few schemes have actually reached the contract stage (aborted before contract). The high ranking of this factor coincides with the previous argument about political debate in Hong Kong. As a result some projects had to be aborted due to political disagreement. The Hong Kong-Zhuhai-Macau Bridge is an apt example of a proposed PPP project being procured traditionally after much negotiation. This obstacle was ranked seventh by the Beijing respondents, and last in the survey of Li (2003). Again the experience of the British in conducting PPP projects is much more plentiful, in that the respondents did not believe that few schemes would reach the contract stage. Similarly, in Beijing, the concepts and feasibility of PPP implementation in infrastructure development is commonly acknowl-

edged by both the governments and private investors. Instead, the major concern is how to achieve greater value for money in a PPP project.

Another observation manifested that the bottom three rankings for both Beijing and Hong Kong were identical. Last of the rank was less employment positions, second from last was reduce the project accountability, and third from last was high project costs. The respondents from both administrative systems shared the same views on the obstacles they believed to be of less threat. The respondents believed that less employment positions was the least significant. This therefore has shown that employment has not been affected irrespective of how projects are procured. The main purpose of introducing PPP projects is not to reduce the project accountability, hence it was logical that both groups of respondents perceived that this obstacle was less significant. Similarly PPP projects are not supposed to result in high project costs, as PPP projects focus on life cycle costs rather than initial capital costs and value for money in the long term. The survey of Li (2003) also provided similar results on the lowest ranked obstacles to those obtained from Beijing and Hong Kong. Ranked at 11th and 12th places were also the obstacles reduce the project accountability and less employment positions. These two obstacles were thus common for PPP projects irrespective of the geographic locations.

As the respondents were asked to rate the fourteen obstacles according to a Likert scale from 1 to 5 (1=least important and 5=most important), a value above "3" would represent that the obstacle is of importance. There was one obstacle in the Beijing ranking that was below the mean value of 3. This was less employment positions with a MS of 2.51. In the Hong Kong ranking this factor also achieved a low value of "2.79." In addition, reduce the project accountability was ranked low by Hong Kong respondents with a MS of only "2.79." Also observed from the mean calculations was that lengthy delays in negotiation was the sole obstacle that indicated a score above "4" (i.e., 4.08). These findings consolidate the previous discussions for the rankings in Beijing and Hong Kong. Interestingly for the ranking of Li (2003) the majority of the obstacles were given a score below 3. Among the thirteen obstacles rated only the top three ranked obstacles achieved a score above 3, and the other 10 obstacles were ranked below. Again this occurrence confirms the previous discussion that the British are much more experienced and confident in conducting PPP projects. Hence the low scores show that they feel the obstacles to be of less threat compared to the Beijing and Hong Kong respondents.

Agreement of the Respondents within Beijing and Hong Kong

As shown in Table 3, the Kendall's coefficient of concordance (W) for the rankings of obstacles was 0.102, 0.132, and 0.094 for "Beijing and Hong Kong," "Beijing," and "Hong Kong," respectively. The computed W 's were all statistically significant with significance level at 0.000.

As the number of attributes considered were above seven, as mentioned previously the Chi-square value would be referred to rather than the W value. According to the degree of freedom the critical value of chi-square was 21.030. For all three groups (Beijing and Hong Kong, Beijing, and Hong Kong) the computed chi-square values were all above the critical value of chi-square (97.673, 75.961, and 35.968 for Beijing and Hong Kong, Beijing, and Hong Kong, respectively). Therefore, the assessment by the

Table 3. Results of Kendall's Concordance Analysis for the Obstacles of PPP

	Beijing and Hong Kong	Beijing	Hong Kong
Number of survey respondents	80	48	32
Kendall's coefficient of concordance (W)	0.102	0.132	0.094
Chi-square value	97.673	75.961	35.968
Critical value of chi-square	21.030	21.030	21.030
Degree of freedom (df)	12	12	12
Asymptotic significance	0.000	0.000	0.000

respondents within each group on their rankings of obstacles is proved to be consistent. This finding ensures that the completed survey questionnaires are valid for analysis.

Agreement of the Respondents between Beijing and Hong Kong

The next stage of the analysis was to test whether there is any substantially similar agreement among the respondents between the two places, which is indicated by the Spearman rank correlation coefficient (r_s) again using the SPSS package. The correlation coefficient of the ranking on obstacles was 0.775 with a significance of 0.002 (Table 4). Therefore, the low significance value coupled with high Spearman rank correlation implied that there was no significant disagreement on the rankings of obstacles between respondents of the two administrative systems.

Furthermore, the independent two-sample t -test was undertaken to examine if there was any significant difference in mean value responses between the two respondent groups for each of the thirteen obstacles discussed. When the calculated significance level is below the statistically significant value of 0.05 for a certain obstacle, a large variation is detected between the opinions of the respondents from Beijing and Hong Kong. Among the t -test results for the 13 obstacles between Beijing and Hong Kong respondents, only two obstacles fell below a significance level of 0.05 (Table 5), while the others were not statistically significant. For the obstacles lack of experience and appropriate skills and lengthy delays in negotiation, the significance levels showed that the respondents from Beijing and Hong Kong shared very different views on their importance. The significance calculated by

Table 4. Results of Spearman Rank Correlation Test between Respondents from Beijing and Hong Kong for the Obstacles for PPP

Comparison	r_s	Significance
Ranking of Beijing ranking versus ranking of Hong Kong	0.775	0.002

Table 5. Results of Independent Two-Sample t -Test for Statistically Significant Obstacles of PPP as Identified by Beijing and Hong Kong Respondents

			Levene's test for equality of variances		t -test for equality of means		
			F	Significance	t	Degree of freedom	Significance (two-tailed)
j	Lack of experience and appropriate skills	Equal variances assumed	0.218	0.642	-2.581	84	0.012
		Equal variances not assumed			-2.574	67.461	0.012
m	Lengthy delays in negotiation	Equal variances assumed	2.282	0.135	-2.568	84	0.012
		Equal variances not assumed			-2.470	59.587	0.016

Levene's Test for equality of variances was considered. This significance was 0.642 and 0.135 for the obstacles lack of experience and appropriate skills and lengthy delays in negotiation, respectively, which were above 0.05, hence equal variances are assumed. The significance for the obstacles is 0.012 meaning that both administrative systems shared very different perspectives on the importance of these obstacles. Referring back to the ranking this is not obvious, as lengthy delays in negotiation were ranked first and second places by the Beijing and Hong Kong respondents, respectively. But a closer look at the differences between the means showed that these two obstacles were rated very differently. For lack of experience and appropriate skills the difference of the score given by the two groups of respondents was 0.67, and for lengthy delays in negotiation the difference was 0.63. On the other hand, for the other obstacles the differences ranged from only 0.05 to 0.33.

Conclusions

The research work presented in this paper has compared the perceptions of respondents from Beijing and Hong Kong on their attitude toward 13 potential obstacles to PPP projects. A total of 87 survey questionnaires were returned for the analysis as discussed above. In addition, the results of this survey were compared to those findings derived by Li (2003) in the United Kingdom.

The comparison found that in general the results of this survey and the findings of Li (2003) were consistent. Therefore, the research hypothesis that similar obstacles would be identified for these jurisdictions was proved to be correct. From the results obtained in Beijing, Hong Kong, and by Li (2003) in the United Kingdom, there was one obstacle rated among the top three obstacles. Respondents from Beijing rated the obstacle lengthy delays in negotiation first, whereas respondents from Hong Kong and United Kingdom rated this obstacle second. The findings reveal that this obstacle was important irrespective of the different jurisdictions. Therefore, it can be concluded that this obstacle is pertinent to both the Western and Asian worlds. Rated second by Beijing respondents was the obstacle lack of experience and appropriate skills. On the contrary, this obstacle was only ranked eighth in Hong Kong and fifth in the United Kingdom. This is probably because Hong Kong has been the gateway to China, as a result of which many renowned international companies have based their offices in Hong Kong. Hong Kong is therefore much more equipped with the necessary expertise and skills for commercial ventures. The United Kingdom is also well equipped with skills particularly with their experience in PPP projects. The third obstacle ranked by the Beijing respondents was lengthy delays because of political debate, which was ranked first in Hong Kong and sixth in the United Kingdom. This has reflected that respon-

dents in both Beijing and Hong Kong have faced problems with delay. The other obstacle ranked within the top three by Hong Kong respondents was very few schemes have actually reached the contract stage (aborted before contract), which was ranked seventh by respondents in Beijing and last by respondents in the United Kingdom. It was also realized that the bottom three obstacles ranked by both Beijing and Hong Kong were identical. These included less employment positions, reduce the project accountability, and high project costs. Two of these were also ranked at the bottom three by the British respondents (less employment positions and reduce the project accountability). In addition, 11 of the 13 obstacles were rated higher by the Beijing respondents. The only two obstacles rated higher by Hong Kong respondents were lengthy delays because of political debate and less employment positions. This coincides with the fact that political interference has often been regarded as an essential factor delaying PPP projects in Hong Kong.

Computation of Kendall's coefficient of concordance showed that the responses within each administrative system were consistent, which implies that the completed survey questionnaires were valid for analysis. In general, the Spearman rank correlation coefficient concluded that there was no significant disagreement on the rankings of obstacles between respondents of the two administrative systems. However, the independent two-sample *t*-test demonstrated that there was significant difference in the mean value between the two administrative systems for lack of experience and appropriate skills (difference in means of 0.67) and lengthy delays in negotiation (difference in means of 0.63). For the other obstacles the mean differences ranged from only 0.05 to 0.33. The results have demonstrated that Hong Kong respondents were much more confident and capable on their experience and skills in conducting PPP projects when compared to the Beijing respondents. Also, tendering procedures were shown to be quite different between the two administrative regions, with the Beijing respondents believing that the tendering process is much lengthier than the respondents from Hong Kong.

The findings obtained in this survey have helped to contribute to developing a best practice framework for implementing PPP in Hong Kong. The findings not only verify the research hypothesis that similar obstacles are found irrespective of geographical difference, it has also helped to verify the results from previous literature, case analysis and also formed a comparative study for Hong Kong, Beijing and the United Kingdom. As a result practitioners involved with PPP projects in both the public and private sectors can avoid the obstacles highlighted so that PPP projects can be delivered more effectively.

Acknowledgments

The work described in this paper was fully supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (RGC Project No. PolyU 5114/05E). Sincere thanks go to Dr. Bing Li and Professor Akintola Akintoye for permitting the research team to adapt their survey questionnaire template. Special gratitude is also extended to those industrial practitioners from both Beijing and Hong Kong, who have kindly participated in the questionnaire survey reported in this paper from October 2007 to December 2007. This paper forms part of the research project entitled "Developing a Best Practice Framework for Public Private Partnerships (PPP) in Hong Kong," from which other deliverables have been produced

with different objectives/scope but sharing common background and methodology.

References

- Askar, M. M., and Gab-Allah, A. A. (2002). "Problems facing parties involved in build, operate, and transport projects in Egypt." *J. Manage. Eng.*, 18(4), 173–178.
- Carrillo, P., Robinson, H., Foale, P., Anumba, C., Bouchlaghem, D. (2008). "Participation, barriers and opportunities in PFI: The United Kingdom experience." *J. Manage. Eng.*, 24(3), 138–145.
- Census and Statistics Department. (2008). "Statistics by subject." (http://www.censtatd.gov.hk/hong_kong_statistics/statistics_by_subject/index.jsp) (April 9, 2008).
- Chan, A. P. C. (2000). "Evaluation of enhanced design and build system—A case study of a hospital project." *Constr. Manage. Econom.*, 18(7), 863–871.
- Chan, A. P. C., Chan, D. W. M., and Ho, K. S. K. (2003). "An empirical study of the benefits of construction partnering in Hong Kong." *Constr. Manage. Econom.*, 21(5), 523–533.
- Chan, A. P. C., Lam, P. T. I., Chan, D. W. M., Sidwell, T., Kajewski, S., and Cheung, E. (2007a). "A research framework for investigating public private partnerships (PPP) in Hong Kong." *Proc., 4th Int. Conf. on Construction in the 21st Century (CITC-IV)—Accelerating Innovation in Engineering, Management and Technology*, Gold Coast, Australia, 334–341.
- Chan, A. P. C., Lam, P. T. I., Chan, D. W. M., Sidwell, T., Kajewski, S., and Cheung, E. (2007b). "From BOT to PPP—A Hong Kong example." *Proc., 2007 Int. Conf. on Concession Public / Infrastructural Projects (ICCP)*, Vol. 9, Dalian Univ. of Technology, Dalian, China, 010–018.
- Chan, D. W. M., Chan, A. P. C., and Lam, P. T. I. (2006). "A feasibility study of the implementation of public private partnership (PPP) in Hong Kong." *Proc., CIB W89 Int. Conf. on Building Education and Research: 2.6—Procurement Management*, CIB, Hong Kong.
- Chan, D. W. M., and Kumaraswamy, M. M. (1996). "An evaluation of construction time performance in the building industry." *Build. Environ.*, 31(6), 569–578.
- Chen, B. (2008). "Bridge set for early finish on new deal." *The Standard*, Aug. 4.
- Corbett, P., and Smith, R. (2006). "An analysis of the success of the private finance initiative as the government's preferred procurement route." *Proc., Accelerating Excellence in the Built Environment Conf.*, World Conference Series on Accelerating Excellence in the Built Environment (WCAEBE), Birmingham, U.K.
- Efficiency Unit. (2003). *Serving the community by using the private sector—An introductory guide to public private partnerships (PPPs)*, Hong Kong Special Administrative Region Government, Hong Kong.
- El-Gohary, N. M., Osman, H., and El-Diraby, T. E. (2006). "Stakeholder management for public private partnerships." *Int. J. Proj. Manage.*, 24(7), 595–604.
- Environment, Transport and Works Bureau. (2004). "Reference guide on selection of procurement approach and project delivery techniques." *Technical Circular No. 32/2004*, Hong Kong Special Administrative Region Government, Hong Kong.
- Grimsey, D., and Lewis, M. K. (2004). *Public private partnerships: The worldwide revolution in infrastructure provision and project finance*, Edward Elgar, Cheltenham, U.K.
- Gunnigan, L., and Eaton, D. (2006). "Addressing the challenges that are emerging in the continued increase in PPP use in the Republic of Ireland." *Proc., CIB W89 Int. Conf. on Building Education and Research*, CIB, Hong Kong.
- Higton, N. (2005). "Using PPP's to deliver successful rail projects." *Proc., Conf. on Public Private Partnerships—Opportunities and Challenges*, Hong Kong Univ., Hong Kong, 51–60.

- Keller, G. (2005). *Statistics for management and economics*, 7th Ed., Thomas Brooks/Cole, Belmont, Calif.
- Koppenjan, J. F. M. (2005). "The formation of public-private partnerships: Lessons from nine transport infrastructure projects in the Netherlands." *Public Adm.*, 83(1), 135–157.
- Li, B. (2003). "Risk management of construction public private partnership projects." Ph.D. thesis, Glasgow Caledonian Univ., U.K.
- Li, B., Akintoye, A., Edwards, P. J., and Hardcastle, C. (2005a). "The allocation of risk in PPP/PFI construction projects in the U.K." *Int. J. Proj. Manage.*, 23(1), 25–35.
- Li, B., Akintoye, A., Edwards, P. J., and Hardcastle, C. (2005b). "Perceptions of positive and negative factors drivers influencing the attractiveness of PPP/PFI procurement for construction projects in the U.K." *Eng., Constr. Archit. Manage.*, 12(2), 125–148.
- Merna, T., and Owen, N. (1998). *Understanding the private finance initiative: The new dynamics of project finance*, Asia Law and Practice, Hong Kong.
- Mustafa, A. (1999). "Public-private partnership: An alternative institutional model for implementing the Private Finance Initiative in the provision of transport infrastructure." *J. Project Finance*, 5(2), 64–79.
- Ng, S. T., and Wong, Y. M. W. (2006). "Adopting non-privately funded public-private partnerships in maintenance projects a case study in Hong Kong." *Eng. Construct. Architect. Manag.*, 13(2), 186–200.
- Ng, T. (2008). "Govt. to have more say in deciding bridge toll." *China Daily Hong Kong Edition*, Aug. 6.
- Oriental Newspaper. (2008). "Opportunity taken too late." *Oriental Newspaper*, Aug. 6 (Chinese version only—English translation).
- Rukuts, I. (2004). "PPP projects in the United Kingdom: The successes and failures." *Proc., Hong Kong Institute of Surveyors 20th Anniversary Conf. on Public Private Partnerships*, The Hong Kong Institute of Surveyors, Hong Kong, H01–H18.
- Sachs, T., Tiong, R. L. K., and Wang, S. Q. (2007). "Analysis of political risks and opportunities in public private partnerships (PPP) in Beijing and selected Asian countries." *Chinese Management Studies*, 1(2), 126–148.
- Satpathy, I., and Das, B. (2007). "Sustainable strategy and policy making module on infrastructure development via PPP mechanisms: a perspective for application in India." *Proc., 2007 Int. Conf. on Concession Public / Infrastructural Projects (ICCP/IP)*, Dalian Univ. of Technology, Dalian, China.
- Shen, L. Y., and Wu, Y. Z. (2005). "Risk concession model for BOT contract projects." *J. Constr. Eng. Manage.*, 131(2), 211–220.
- Siegel, S., and Castellan, N. J. (1988). *Nonparametric statistics for the behavioral sciences*, McGraw-Hill, New York.
- Statistical Package for Social Sciences (SPSS). (2002). *SPSS 11.0 statistical algorithms*, SPSS Inc.
- Sun, Y., Fang, D. P., Wang, S. Q., Dai, M. D., and Lv, X. Q. (2008). "Safety risk identification and assessment for Beijing Olympic venues construction." *J. Manage. Eng.*, 24(1), 40–47.
- Wang, S. Q. (2006). "Lessons learnt from the PPP practices in China." *Proc., Asian Infrastructure Congress 2006: Keynote Speech*, IAPF, Hong Kong.
- Wikipedia. (2008a). "Beijing." <http://en.wikipedia.org/wiki/Beijing> (Nov. 20, 2008).
- Wikipedia. (2008b). "West Kowloon Cultural District." http://en.wikipedia.org/wiki/West_Kowloon_Cultural_District (April 9, 2008).
- Xenidis, Y., and Angelides, D. (2005). "The financial risks in build-operate-transfer projects." *Constr. Manage. Econom.*, 23(4), 431–441.
- Zayed, T. M., and Chang, L. M. (2002). "Prototype model for build-operate-transfer risk assessment." *J. Manage. Eng.*, 18(1), 7–16.
- Zhang, X., and AbouRisk, S. S. (2006). "Relational concession in infrastructure development through public-private partnerships." *Proc., CIB W89 Int. Conf. on Building Education and Research*, CIB, Hong Kong.
- Zhang, X. Q. (2001). "Procurement of privately financed infrastructure projects." Ph.D. thesis, Univ. of Hong Kong, Hong Kong Special Administrative Region.