

Critical Success Factors for PPPs in Infrastructure Developments: Chinese Perspective

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Abstract: With the rapid growth of the Chinese economy, the desperate demand for infrastructure developments has created bottlenecks in the country's sustainable development. Infrastructure investment could not be funded completely by the government alone. Taking Beijing as an example, there will be about 2,400 infrastructure projects to be developed during 2006–2010 with a total investment of over RMB 470 billion, which may impose budgetary pressure on the government. As a result, public-private partnership (PPP) could be considered as a favorable option to help provide these rapidly demanded public works and services. In order to investigate the potential for adopting PPPs in the People's Republic of China, this paper aims to explore the critical success factors (CSFs) necessary to conduct PPP projects. The views from Chinese experts were collected via an empirical questionnaire survey. The respondents were invited to rate a total of 18 CSFs that contribute to the success of PPP projects as gleaned from the contemporary literature. The results of this survey were analyzed by the factor analysis technique. The findings showed that the 18 CSFs could be grouped into five underlying factors including: Factor 1—stable macroeconomic environment; Factor 2—shared responsibility between public and private sectors; Factor 3—transparent and efficient procurement process; Factor 4—stable political and social environment; and Factor 5—judicious government control.

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Introduction

The People's Republic of China (PRC) is one of the most densely populated countries in the world. The United Nations (United Nations Economic Commission for Europe 2007) forecasted that urban population in the PRC would increase from 536 million in 2005 to 827 million in 2025. The percentage of the urban population in the PRC would therefore increase from 41% in 2005 to 57% in 2025. The urban population is expected to grow at a faster pace than the total population. To alleviate the negative impact of unorganized urbanization growth, the PRC government is promoting the development of public transportation to relieve traffic

jams, reduce pollution, and enhance mobility for urban commuters (Asian Development Bank 2005). Mass rapid transit has been prioritized in the 11th Five-Year Plan as a key transport mode in megacities. Other public facilities such as water supply, gas supply, and waste disposal are also in high demand to cope with the increasing urbanization growth (Ministry of Construction 2004). However, inadequate government funding may limit the development of megasize infrastructure projects. Public-private partnership (PPP) financing modalities have been identified by the PRC country strategy and program update (2006–2008) as innovative tools for financing major infrastructure projects (Asian Development Bank 2005).

The PPP 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 public infrastructure or services. With the fast pace of market-oriented transformation in the planned economy of China, there is a need to develop PPP modalities which could be applied to the huge infrastructure developments to meet the needs of PRC's population. This study would identify the critical success factors (CSFs) necessary for PPP projects in China. As a result, an alternative solution can be provided to help streamline the rapid urban development scenario being faced by the PRC government.

Literature Review of PPP CSFs

The CSFs are defined as “those few key areas of activity in which favorable results are absolutely necessary for a manager to reach

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his/her goals" (Hardcastle et al. 2005). A comprehensive literature review to identify the CSFs of PPP has been conducted. Relevant published literature including textbooks, research reports, journal articles, conference papers, and internet materials were reviewed thoroughly. Table 1 shows a summary of the analysis of these pieces of literature. From the literature review, 15 key CSFs of PPP were identified. For each CSF identified the frequency at which it was mentioned among the sampled literature was recorded to indicate its relative state of being aware of. The results found that the identified CSFs could be grouped under seven principal headings:

1. Equitable allocation of risks
 - Appropriate risk allocation.
2. Strong private sector
 - Strong private consortium;
 - Good partners' relationship;
 - Technology transfer; and
 - Effective management control.
3. Judicious government control
 - Government guarantee;
 - Consultation with end-users; and
 - Appropriate project identification.
4. Transparent and efficient procurement process
 - Competitive and transparent procurement process; and
 - Clear project brief and client requirements.
5. Project economic viability
 - Project economic viability; and
 - Business diversification.
6. Adequate legal framework and stable political environment
 - Strong government support; and
 - Stable and transparent political/social situation.
7. Available financial market
 - Available financial market.

Research Methodology

Collection of Research Data

An empirical questionnaire survey was undertaken in China (including the Hong Kong Special Administrative Region, which will be referred to as Hong Kong from here onwards) from October to December 2007 to analyze the CSFs that contribute to the success of PPP projects in China. In this study, the target survey respondents of the questionnaire included industrial practitioners from the public, private, and other sectors. These respondents were requested to rate their degree of agreement against each of the identified CSFs 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 with PPP projects. Survey questionnaires were sent to 197 target respondents (102 in China and 95 in Hong Kong). It was anticipated that some of these target respondents would have colleagues and personal connections knowledgeable in the area of PPP and would be interested 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 87 completed questionnaires (53 from China and 34 from Hong Kong) were returned representing a response rate of 44%. The questionnaire respondents comprised experienced practitioners in the industry. As shown in Fig. 1, over half of the respondents possessed more than 10 years of industrial experience. Also, approximately one-third had 21 or above years of construction experience.

Fig. 2 shows the breakdown of questionnaire respondents who have been involved with PPP projects. Given the few build-operate-transfer (BOT)/PPP projects conducted in Hong Kong, it was a surprise to find that approximately 40% of the respondents gained previous experience. Without doubt, some of these may have had experience with local BOT projects or PPP projects overseas, but still the experience of these respondents confirmed the quality of the responses from the survey conducted. In addition, among those respondents who have acquired experience with PPP projects, 10% had previously been involved with at least five projects. Once again this reassures the value and reliability of the findings. In addition, Fig. 3 shows that among these respondents, 45% of them were from the private sector, 16% from the public sector, and 39% from other organizations (mainly academics and researchers).

Analysis Technique

Factor Analysis Technique

Factor analysis (FA) is a statistical technique used to identify a relatively small number of individual factors that can be used to represent relationships among sets of many interrelated variables (Norusis 2008). This technique is powerful to reduce and regroup the individual factors identified from a larger number to a smaller and more critical one by scores of the responses (Lam et al. 2008).

Due to the large number of CSFs considered in this study it was important to define a set of commonalities. The number of individual factors would be required to represent that set of data was determined by examining the total percentage of variance explained by each individual factor. In this investigation, principal components analysis (PCA) was used to identify the underlying grouped factors because of its simplicity and distinctive characteristic of data-reduction capacity for extraction.

In order to obtain a clearer image, extraction with Promax rotation and Kaiser normalization was conducted through the Statistical Package for Social Sciences (SPSS) FACTOR program. In fact, various methods of rotation including Varimax, Oblimin, Quartimax, and Equamax were also tried out. However Promax gave the highest individual factor loadings for the same set of individual factors and more interpretable results overall, therefore Promax rotation method was finally selected for further discussion.

Kaiser-Meyer-Olkin Measure

The appropriateness of the model was evaluated before using FA in this research. The sampling adequacy using Kaiser-Meyer-Olkin (KMO) and Barlett's test of sphericity can be used to test out the appropriateness (Fox and Skitmore 2007).

The KMO statistic varies between 0 and 1. A value of 0 indicates that the sum of partial correlations is large relative to the sum of correlations, indicating diffusion in the pattern of correlations and, hence, FA would be inappropriate (Norusis 2008). In contrast, a value close to 1 indicates that patterns of correlations are relatively compact and FA would yield distinct and reliable individual factors. The KMO value should be higher than the acceptable threshold of 0.5 for a satisfactory FA to proceed (Norusis 2008). The acceptance level of KMO value is indicated in Table 2 (Field 2005).

Barlett's Test for Sphericity

To reinforce the appropriateness of FA, the Barlett's test for sphericity is also carried out to highlight the presence of correlations

Table 1. CSFs of PPP from Published Literature

	CSFs of PPP															
	Competitive and transparent procurement process	Project economic viability	Government guarantee	Available financial market	Clear project brief and client requirements	Business diversification	Strong private consortium	Good partners' relationship	Strong government support	Consultation with end-users	Appropriate risk allocation	Stable and transparent political/ social situation	Appropriate project identification	Effective management control	Technology transfer	Total number of CSFs from each literature
Li et al. (2005)	x	x	x	x												4
Jefferies (2006)	x				x	x										3
Abdul-Rashid et al. (2006)		x					x	x	x							4
Corbett and Smith (2006)	x	x		x	x	x	x	x	x	x						9
Zhang (2005)	x	x	x	x			x	x			x					7
El-Gohary et al. (2006)									x							1
Qiao et al. (2001)	x	x									x	x	x	x	x	7
Nijkamp et al. (2002)		x										x				2
Jamali (2004)					x				x			x	x			4
Jefferies et al. (2002)	x			x			x									3
Tam et al. (1994)		x					x	x	x			x	x	x		7
Tiong (1996)		x	x				x						x			4
Birnie (1999)							x									1
Grant (1996)											x					1
Kanter (1999)			x					x	x							3
Gentry and Fernandez (1997)	x															1
Akintoye et al. (2001)				x												1
Total number of citations for a certain CSF	7	8	4	5	3	2	7	5	6	1	3	4	4	2	1	62

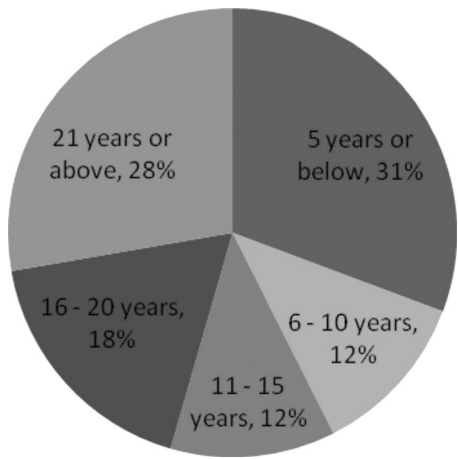


Fig. 1. Pie chart showing the number of years of working experience in construction industry for the survey respondents

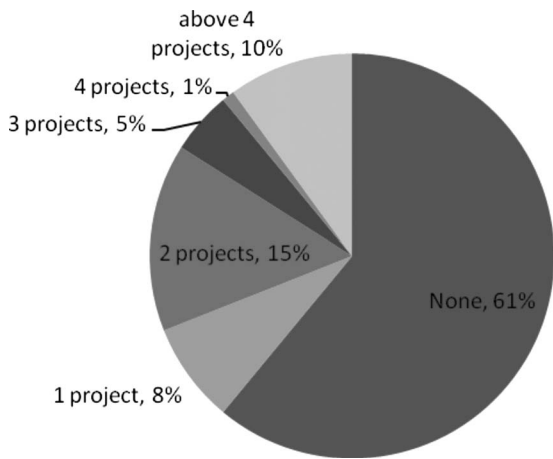


Fig. 2. Pie chart showing the number of PPP projects the survey respondents have been involved with

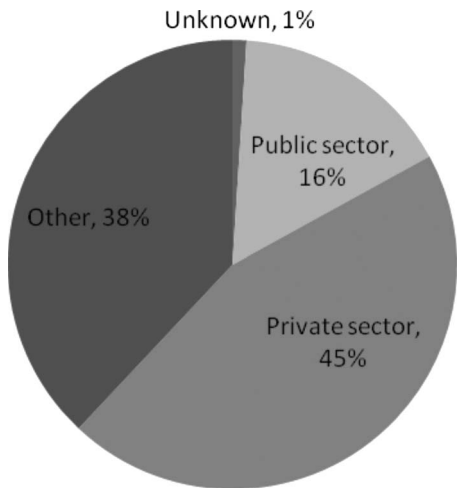


Fig. 3. Background of the questionnaire respondents

Table 2. Acceptance Level of KMO Value (Field 2005)

KMO value	Degree of common variance
0.90–1.00	Excellent
0.80–0.89	Good
0.70–0.79	Middling
0.60–0.69	Mediocre
0.50–0.59	Poor
0.00–0.49	“Forget it”

among the variables. It is used to test the hypothesis that the correlation matrix is an identity matrix, which indicates that there is no relationship among the items (Pett et al. 2003). When the value of the test statistic for sphericity is large and the associated significance level is small, the population correlation matrix is not an identity matrix [Statistical Package for Social Sciences (SPSS) 1997].

Previous Research on PPP CSFs

The CSFs identified from reported literature (as discussed previously in this paper) were compared to those researched by Li (2003). The results in Fig. 4 show that all CSFs identified by literature compliment those sought by Li (2003). In the literature

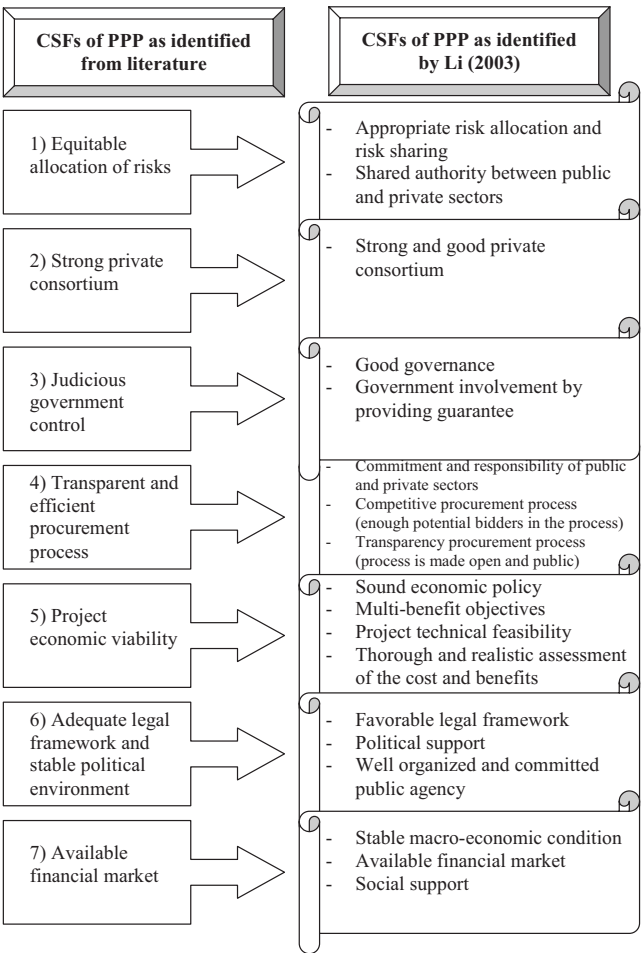


Fig. 4. Summary of CSFs for PPP as identified from literature and by Li (2003)

Table 3. Mean Scores, SDs, and Rankings for the CSFs of PPP

	China and Hong Kong				China				Hong Kong			
	N	Mean	SD	Rank	N	Mean	SD	Rank	N	Mean	SD	Rank
a. Stable macroeconomic condition	87	4.06	0.944	4	53	4.19	0.962	4	34	3.85	0.892	4
b. Favorable legal framework	87	4.24	0.915	1	53	4.36	0.963	1	34	4.06	0.814	1
c. Sound economic policy	87	3.89	0.868	7	53	3.98	0.971	8	34	3.74	0.666	7
d. Available financial market	87	3.98	0.835	5	53	4.15	0.886	5	34	3.71	0.676	8
e. Multibenefit objectives	87	3.83	1.037	10	53	4.04	0.960	6	34	3.50	1.080	16
f. Appropriate risk allocation and risk sharing	87	4.15	0.995	2	53	4.34	0.960	2	34	3.85	0.989	5
g. Commitment and responsibility of public and private sectors	87	4.11	0.895	3	53	4.21	0.927	3	34	3.97	0.834	2
h. Strong and good private consortium	87	3.91	0.830	6	53	3.91	0.904	10	34	3.91	0.712	3
i. Good governance	87	3.63	0.954	15	53	3.60	0.987	17	34	3.68	0.912	10
j. Project technical feasibility	87	3.60	0.895	16	53	3.62	0.925	15	34	3.56	0.860	15
k. Shared authority between public and private sectors	87	3.54	0.950	17	53	3.62	0.860	15	34	3.41	1.076	18
l. Political support	87	3.87	1.129	8	53	3.94	1.099	9	34	3.76	1.182	6
m. Social support	87	3.44	1.053	18	53	3.43	1.065	18	34	3.44	1.050	17
n. Well-organized and committed public agency	87	3.66	0.986	14	53	3.66	1.108	14	34	3.65	0.774	12
o. Competitive procurement process (enough potential bidders in the process)	87	3.76	1.034	11	53	3.81	1.226	12	34	3.68	0.638	9
p. Transparency procurement process (process is made open and public)	86	3.87	0.980	9	53	4.00	1.019	7	33	3.67	0.890	11
q. Government involvement by providing guarantee	87	3.75	1.070	12	53	3.83	1.033	11	34	3.62	1.129	14
r. Thorough and realistic assessment of the cost and benefits	87	3.74	0.946	13	53	3.79	0.968	13	34	3.65	0.917	13

Note: N=number of survey respondents and SD=standard deviation.

review conducted for this study, seven principal groups of CSF were identified. Group (1) “equitable allocation of risks” was found to be overlapped with the CSFs “appropriate risk allocation and risk sharing” and “shared authority between public and private sectors” identified by Li (2003) as these are all related to risk and responsibility. Group (2) “strong private sector” was perceived to be very similar to “strong and good private consortium” from the study of Li (2003) as both focus on the private party’s ability. Group (3) “judicious government control” can cover both “good governance” and “government involvement by providing guarantee” which were determined by Li (2003) as they are all concerned with government factors. Group (4) “transparent and efficient procurement process” can be related to the CSFs of Li (2003) regarding the procurement process including “commitment and responsibility of public and private sectors,” “competitive procurement process (enough potential bidders in the process),” and “transparency in procurement process (process is made open and public).” Other CSFs identified by Li (2003) such as “sound economic policy,” “multibenefit objectives,” “project technical feasibility,” and “thorough and realistic assessment of the cost and benefits” could all be subsumed under Group (5) “project economic viability” due to their similarities under economic focus. Group (6) “adequate legal framework and stable political environment” share similarities with “favorable legal framework,” “political support,” and “well-organized and committed public agency” due to their commonalities with legislation and politics. Finally, Group (7) “available financial market” overlaps with the “stable macroeconomic condition,” “available financial market,” and “social support” of Li (2003) due to their focus on the financial environment.

The questionnaire template designed by Li (2003) was therefore adopted for this study. Although the writers could have developed their own research questionnaire, there were several advantages foreseeable to adopt the survey questionnaire of Li

(2003) 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, and third, by administering the questionnaire of Li (2003) 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. Bing Li 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, U.K.

Furthermore, this questionnaire covers several different aspects of PPP but only the part related to CSFs is discussed in this paper. In the following discussions, much reference will be made to Li et al. (2005). This was a publication specifically looking at the CSF section derived of Li (2003).

Results and Discussion of FA

FA was conducted based on the rankings of 18 CSFs (Table 3 shows details of the number of respondents, mean, SD, and rank for each CSF). Table 4 contains the details of initial statistic for each of the 18 individual factors. Five underlying grouped factors were generated from FA. The descriptions of how these were labeled are described later in this paper. The underlying grouped factors which include their associated individual factors are also given. Each individual factor is highly dependent on only one of the grouped CSFs. The loading on each individual factor should exceed or be close to 0.5 (Akintoye 2000). The total variance

Table 4. Structure of Principal Factors Extraction and Promax Rotation on the 18 CSFs of PPP

Item	Factor loading	Eigenvalue	Percent of variance explained	Cumulative percent of variance explained
Factor 1. Stable macroeconomic environment		6.735	37.414	37.414
Sound economic policy	0.814			
Favorable legal framework	0.800			
Stable macroeconomic condition	0.765			
Appropriate risk allocation and risk sharing	0.753			
Available financial market	0.735			
Multibenefit objectives	0.635			
Factor 2. Shared responsibility between public and private sectors		1.651	9.170	46.584
Shared authority between public and private sectors	0.834			
Commitment and responsibility of public and private sectors	0.798			
Project technical feasibility	0.757			
Thorough and realistic assessment of the cost and benefits	0.601			
Factor 3. Transparent and efficient procurement process		1.501	8.336	54.920
Competitive procurement process	0.897			
Transparency procurement process	0.812			
Well-organized and committed public agency	0.675			
Factor 4. Stable political and social environment		1.257	6.986	61.906
Political support	0.861			
Social support	0.834			
Strong and good private consortium	0.671			
Good governance	0.612			
Factor 5. Judicious government control		1.139	6.327	68.234
Government involvement by providing guarantee	0.805			

explained by each individual factor is listed in the column named “factor loading.” The percent of the variance and cumulative percent of the variance explained are also shown in Table 4.

Appropriateness of the Analysis Technique

Various tests were required to examine the appropriateness of FA for the extraction. The KMO measure of sampling adequacy and Bartlett’s test of sphericity for the extraction individual factors were conducted in this research. The KMO value of this research is 0.801 which shows a good degree of common variance (Table 5).

The value of the test statistic for Bartlett’s sphericity is large (chi-square value=742.799) and the associated significance level is small (p -value=0.000), implying that the population correlation matrix is not an identity matrix. The Cronbach α is a model for checking internal consistency (reliability) between 0 and 1, based on the average interitem correlation. The standard rule is that α must be greater than approximately 0.70 to conclude that the scale is reliable (SPSS 2003). The overall α value for the 18 CSFs is 0.896, indicating that there is good internal consistency

reliability. As the requirement of KMO value and the Bartlett’s test of sphericity are both met, it can be concluded that FA was appropriate for this research.

Interpretation of the Results

Five underlying grouped factors were extracted in this case, totally accounted for 68% of the variance in responses. SPSS drops the individual factors “6” to “18” as their eigenvalues are less than 1.0. This represents that they are less influential than the five observed underlying grouped factors. The 18 original CSFs of PPP were all included in one of these five underlying grouped factors. The criteria for group classification were that a variable, which has the highest loading with a value larger than 0.50 in one component, belongs to that component (Awakul and Ogunlana 2002). The underlying grouped factors accounted for 37.41, 9.17, 8.34, 6.99, and 6.33% of the variance, respectively.

All loadings of the 18 individual factors were greater than 0.5. The higher the absolute value of the individual factor loading (which cannot exceed a maximum of 1.0), the more a particular individual factor contributes to its underlying grouped factor (Proverbs et al. 1997). The values reflect the degree of contribution of individual factors to each underlying grouped factor. It is observed that the factor loadings and the interpretation of the individual factors extracted were reasonably consistent. Fig. 5 shows a plot of total variance associated with each underlying grouped factor. The plot indicates a distinct break between the steep slope of the large individual factors and the gradual trailing off of the rest. This gradual trailing off is referred to as the

Table 5. Results of KMO and Bartlett’s Test for the CSFs of PPP

KMO measure of sampling adequacy	0.801
Bartlett’s test of sphericity	Approximate chi-square
	742.799
	Degree of freedom
	153
	Significance
	0.000

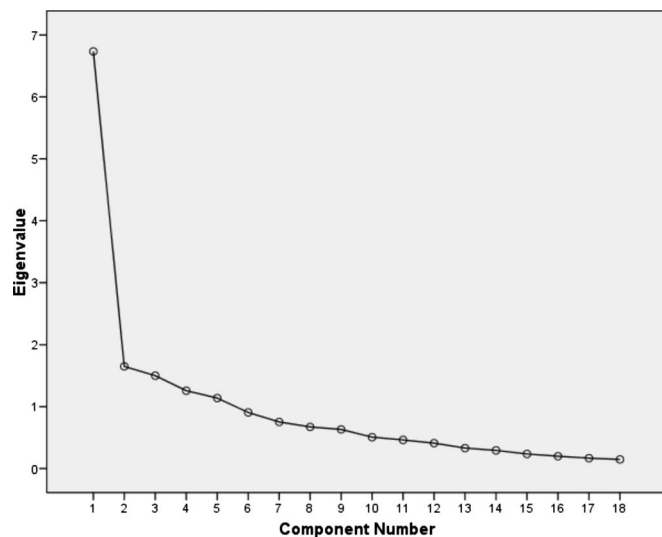


Fig. 5. Scree plot of the 18 CSFs for PPP

“scree” as it resembles the rubble that forms at the foot of a mountain (Norusis 2008). The figure confirms that a 5-factor model should be sufficient for the research model. A positive sign of the factor loading represents that the individual factors is positively correlated to the criticality of individual factors contributing to the success of PPP and vice versa.

Five Underlying Grouped Factors in China

PCA was used to identify the CSFs of PPP. PCA, with Promax rotation conducted on the 18 independent variables produced five underlying grouped factors. The grouped CSFs were analyzed in descending order of significance to determine underlying features that linked them. A new underlying grouped factor was appropriately labeled in accordance with the set of individual factors it contained. In order to facilitate the explanation of the results of FA, it is necessary to assign an identifiable, collective label to the groups of individual factors of high correlation coefficients, as each of the underlying grouped factors is an aggregation of individual factors (Sato 2005). It is however stressed that the suggested label is subjective and other researchers may use a different label. For the five underlying grouped factors the labels identified were:

- Factor 1—stable macroeconomic environment;
- Factor 2—shared responsibility between public and private sectors;
- Factor 3—transparent and efficient procurement process;
- Factor 4—stable political and social environment; and
- Factor 5—judicious government control.

Explanation of the Underlying Grouped CSFs of PPP

The meanings of the five underlying grouped CSFs of PPP in this study are interpreted as follows.

Stable Macroeconomic Environment (Factor 1)

This underlying group consists of six CSFs including: (1) sound economic policy; (2) favorable legal framework; (3) stable macroeconomic condition; (4) appropriate risk allocation and risk sharing; (5) available financial market; and (6) multibenefit objectives. These CSFs are all related to ensuring a stable macroeco-

nomics environment. The CSFs under this underlying group cover policy issues, legislation, risk allocation, economics, and added value for adopting PPP.

The CSF with the highest factor loading in this group is sound economic policy with 0.814. For projects where the major source of revenue to the private sector is generated from direct tariffs levied on users, there are revenue risks that can go beyond the control of the private sector such as, for example, future usage level and permitted tariff charges. There may also be unforeseen risks during the course of project life. To ensure project economic viability, the government may consider some forms of government guarantees, joint investment funding, or supplemental periodic service payments to allow the private sector cover the project costs and earn reasonable profits and investment returns. At the same time, the government should take due consideration of private sector's profitability requirements in order to have stable arrangements in PPP projects. Alternative sources of income and financing such as property development opportunities along the railway can be sought to bridge the funding gap for private investors (Abdul-Rashid et al. 2006; Corbett and Smith 2006; Li et al. 2005; Nijkamp et al. 2002; Qiao et al. 2001; Tam et al. 1994; Tiong 1996; Zhang 2005).

The CSF with the next highest factor loading is favorable legal framework with 0.800. As mentioned by the National Treasury Public Private Partnership Unit of South Africa (2007), an independent, fair, and efficient legal framework is a key factor for successful PPP project implementation. Sufficient legal resources at reasonable costs should be available to deal with the amount of legal structuring and documentation required. A transparent and stable legal framework should help to make the contracts and agreements bankable. An adequate dispute resolution system should help to ensure stability in the PPP arrangements (United Nations Economic Commission for Europe 2007). Appropriate governing rules, regulations, and reference manuals related to PPP have been well-established in some developed countries (e.g., U.K., Australia, Canada, South Africa, etc.) to facilitate the effective application of PPP procurement approach.

Third is the CSF stable macroeconomic condition. Li et al. (2005) mentioned that, for successful PPP project implementation, governments must ensure that economic conditions are favorable. The fourth CSF in this group is appropriate risk allocation and risk sharing. A core principle in PPP arrangement is the allocation of risk to the party best able to manage and control it (Efficiency Unit 2003). Logically, the government would prefer to transfer risks associated with asset procurement and service delivery to the private sector participants, who are generally more efficient and experienced in managing them. But the government should be reasonable to take up risks that are out of the control of private sector participants. In all cases, the government should ensure there are measures in place to manage the risk exposure rather than leaving it open to the private sector. Likewise before committing to the projects, the private sector participants should fully understand the risks involved and should be prudent in pricing and managing the risks appropriately (Grant 1996; Qiao et al. 2001; Zhang 2005).

The fifth CSF in this group is available financial market. Many researchers (Akintoye et al. 2001; Corbett and Smith 2006; Jafferries et al. 2002; Li et al. 2005; Zhang 2005) have found that project financing is a key factor for private sector investment in public infrastructure projects. The availability of an efficient and mature financial market with the benefits of low financing costs and a diversified range of financial products would be an incentive for private sector taking up PPP projects.

Similar to the findings in this study, Li et al. (2005) found that multibenefit objectives are associated to a low factor loading. In this study, the factor loading for this CSF is found to be 0.635, and in Li's study it is 0.605.

Shared Responsibility between Public and Private Sectors (Factor 2)

This underlying group consists of four CSFs including: (1) shared authority between public and private sectors; (2) commitment and responsibility of public and private sectors; (3) project technical feasibility; and (4) thorough and realistic assessment of the cost and benefits. The CSFs under this underlying group mainly focus on the sharing of responsibilities between the main parties in a PPP arrangement. In addition, this group also covers those CSFs related to the project technicality and assessment of benefits.

The highest factor loading in this group is 0.834, achieved by the CSF shared authority between public and private sectors. It is important that the responsibilities of each party are appropriately defined and shared. In order for PPPs to work there must be a partnership in place.

The second CSF in this group is commitment and responsibility of public and private sectors. As explained by Li et al. (2005), the attitude of the actors (or stakeholders) in a PPP project has an influence on the quality of outputs. Thus "soft" individual factors such as stakeholder relationships and stakeholder management must also be considered.

The third CSF in this group is project technical feasibility. Li et al. (2005) described that traditionally, technical issues are among the most important considerations in a project feasibility study. When considering PPP procurement options, it is important to review the associated technical problems. In particular, the private contractor needs to ensure that any engineering uncertainties are resolved.

The last CSF in this group is thorough and realistic assessment of the cost and benefits. For this CSF, Li et al. (2005) also explained that before a project is subjected to the procurement process, the public client should ensure that all the potential options that are beneficial to the government and end-users are considered as part of the complete project feasibility study.

Transparent and Efficient Procurement Process (Factor 3)

There are three CSFs under this underlying group. These CSFs are related to the procurement process of PPP projects and they included: (1) competitive procurement process (enough potential bidders in the process); (2) transparency procurement process (process is made open and public); and (3) well-organized and committed public agency. The top two CSFs in this group gained a factor loading of 0.897 and 0.812, respectively. A transparent and efficient procurement process is essential in lowering the transaction costs and shortening the time in negotiation and completing the deal. Clear project brief and client requirements should help to achieve these in the bidding process. In most cases, competitive bidding solely on price may not help to secure a strong private consortium and obtain value for money for the public. The government should take a long-term view in seeking the right partner (Corbett and Smith 2006; Gentry and Fernandez 1997; Jefferies et al. 2002; Jefferies 2006; Li et al. 2005; Qiao et al. 2001; Zhang 2005).

The last CSF in this group is well-organized and committed public agency. Li et al. (2005) described that effective procurement cannot be separated from the actors (stakeholders). This

supports the institutional structure for a PPP project in that policy makers, government departments, and their agency are fundamental for successful PPP implementation.

Stable Political and Social Environments (Factor 4)

Similar to Factor 2, this underlying group also consists of four CSFs including (1) political support; (2) social support; (3) strong and good private consortium; and (4) good governance. The CSFs in this group are related to the support given to PPP projects and also the ability of the public and private sectors hence is related to the overall environment situation. The factor loadings for the CSFs political support and social support are 0.861 and 0.834, respectively. Successful PPP implementation requires a stable political and social environment, which in turn relies on the stability and capability of the host government (Wong 2007). Political and social issues that go beyond private sector's domain should be handled by the government. In the event that the private sector participants are affected, they should be adequately compensated. Unstable political and social environments have resulted in some failed rail projects (e.g., frequent change in government premiers in Bangkok leading to the cancellation of many new public infrastructure projects originally procured under the PPP approach).

The third CSF in this group is strong and good private consortium. The government in contracting out the PPP projects should ensure that the parties in the private sector consortium are sufficiently competent and financially capable of taking up the projects. This suggests that private companies should explore other participants' strengths and weaknesses and, where appropriate, join together to form a consortia capable of synergizing and exploiting their individual strengths. Good relationship among partners is also critical because they all bear relevant risks and benefits from the cooperation (Abdul-Rashid et al. 2006; Birnie 1999; Corbett and Smith 2006; Jefferies et al. 2002; Kanter 1999; Tam et al. 1994; Tiong 1996; Zhang 2005).

The last CSF in this group is good governance. A committed and knowledgeable public client will be able to coordinate with the private parties much more effectively. The public client will also act as a monitoring authority to ensure that the private consortium acts according to the agreement.

Judicious Government Control (Factor 5)

The fifth underlying group only contains one CSF: (1) government involvement by providing guarantee. This CSF was grouped under judicious government control. The factor loading for this CSF is relatively high at 0.805. Under PPP contracts the government should be concerned that the assets are procured and services are delivered on-time with good quality and meet the preagreed service benchmarks or requirements throughout the life of the contract. However, the government should be less concerned with "how" these are achieved and should not impose undue restrictions and constraints on private sector participants. The government should focus on industry and service regulation; should be flexible in adopting innovations and new technology; and should provide strong support and make incentive payments to the private sector where appropriate. On the other hand, the government should retain controls in case of default and be prepared to step in and reprovide the service if necessary (Abdul-Rashid et al. 2006; Corbett and Smith 2006; El-Gohary et al. 2006; Jamali 2004; Kanter 1999; Li et al. 2005; Tam et al. 1994; Tiong 1996; Zhang 2005).

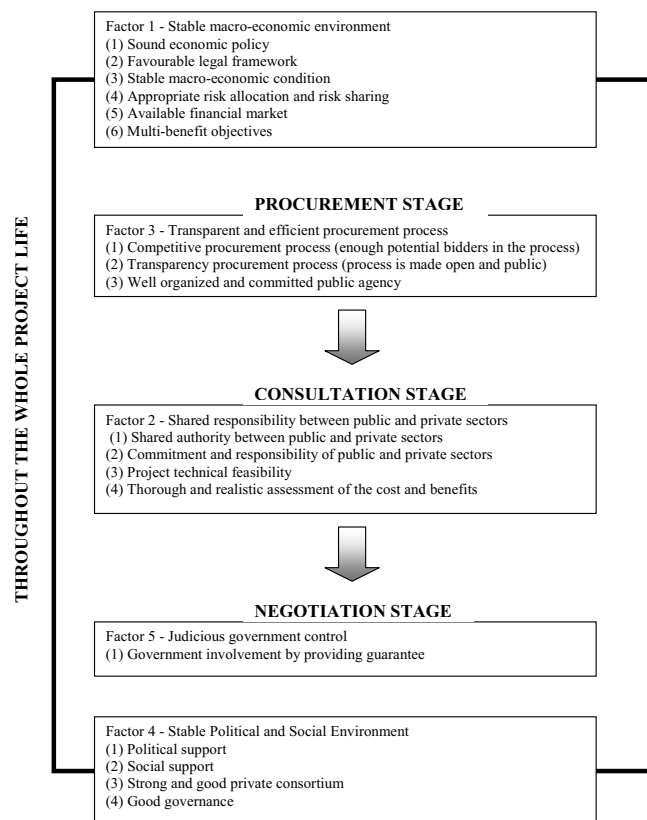


Fig. 6. Diagram showing the relationship between the five factor groupings in China

Relationship of the Underlying Grouped CSFs of PPP

A relationship and order between the identified underlying grouped factors was observed. Fig. 6 illustrates that the groups of CSFs should be considered in a certain order. This order is unrelated to the relative importance of the individual factors considered, but more to do with the corresponding phase of the project life cycle for these individual factors to be considered. The first underlying grouped factor that should be considered is Factor 3 transparent and efficient procurement process. The individual factors within this group are all related to the procurement process, so should be considered early on in a project. These individual factors should even be considered before the procurement process to ensure that they can be taken into action well in advance. The next underlying grouped factor that should be considered is Factor 2 shared responsibility between public and private sectors. The individual factors within this group are all related to the negotiation stage between the public and private parties. These individual factors would therefore need to be considered before and during the first consultation between these parties to ensure that they are taken into consideration. The third underlying grouped factor to be considered is Factor 5 judicious government control. It is anticipated that during the negotiation stage the private sector may request the government for certain guarantees to lower their risks or the government may consider to offer certain guarantees in order to attract the private sector. Either way this underlying grouped factor should be considered next in line. Among the five underlying grouped factors there are two remaining including Factor 1 stable macroeconomic environment and Factor 4 stable political and social environment. The individual factors within

these groups are related to the general environment hence are important and should be considered continuously throughout the project life.

Comparison of the Underlying CSFs of PPP between China and the United Kingdom

Table 6 shows a comparison of the underlying grouped factors from this study and the study of Li et al. (2005). The results showed that although the order of the groupings is quite different, they showed a few similarities.

The first underlying grouped factor derived for China was stable macroeconomic environment. Similarly, Factor 4 favorable economic conditions for the United Kingdom, shared a similar emphasis on ideal economic conditions. For China, this group contained six individual factors, but for the United Kingdom, there were only two. Both of which were contained in the Chinese group (stable macroeconomic conditions and sound economic policy).

Factor 3 transparent and efficient procurement process for China, and Factor 1 effective procurement for the United Kingdom share a similar meaning. Both emphasize a smoother procurement process. For China, only three individual factors were contained in this group, whereas for the United Kingdom this group contained seven individual factors. Regardless of this observation, the three individual factors in the China group were also contained in the U.K. group. These individual factors included: competitive procurement process (enough potential bidders in the process); transparency procurement process (process is made open and public); and well-organized and committed public agency.

Factor 5 judicious government control for China and Factor 3 government guarantee for the United Kingdom both involve individual factors that relate to government issues. The first contained only one individual factor and the latter only two. The individual factor government involvement by providing a guarantee was found in both these underlying grouped factors.

The other underlying grouped factors did not appear to share similar meanings. Despite so, Factor 2 shared responsibility between public and private sectors for China and project implementability for the United Kingdom contained two similar individual factors including commitment and responsibility of public and private sectors and project technical feasibility. Although the groups represented different meanings, these individual factors were believed to be applicable for both groups.

The four individual factors within Factor 4 stable political and social environment for China are covered in Factors 1 and 2 for the United Kingdom. An exception was the individual factor political support which was not included in any of the underlying grouped factors after the FA for the U.K. survey.

Lastly, the Factor 5 for the United Kingdom contained only one individual factor available financial market. This individual factor was contained within Factor 1 for China.

Therefore, the FA comparison for the two countries has shown that among the five underlying grouped factors for each, there were three groups which shared a similar theme and meaning. Referring to the names of the underlying grouped factors used for China, these three groups included: stable macroeconomic environment; transparent and efficient procurement process; and judicious government control. This finding indicated that these three underlying grouped factors could be applicable to all PPP projects irrespective of geographical locations.

Table 6. Underlying Grouped CSFs of PPP Derived from This Study between China and the United Kingdom (Li 2003)

Underlying grouped factor	China	U.K. ^a
1	Stable macroeconomic environment (1) Sound economic policy (2) Favorable legal framework (3) Stable macroeconomic condition (4) Appropriate risk allocation and risk sharing (5) Available financial market (6) Multibenefit objectives	Effective procurement (1) Transparency in the procurement process (2) Competitive procurement process (3) Good governance (4) Well-organized and committed public agency (5) Social support (6) Shared authority between public and private sectors (7) Thorough and realistic assessment of the costs and benefits
2	Shared responsibility between public and private sectors (1) Shared authority between public and private sectors (2) Commitment and responsibility of public and private sectors (3) Project technical feasibility (4) Thorough and realistic assessment of the cost and benefits	Project implementability (1) Favorable legal framework (2) Project technical feasibility (3) Appropriate risk allocation and risk sharing (4) Commitment and responsibility of public and private sectors (5) Strong private consortium
3	Transparent and efficient procurement process (1) Competitive procurement process (enough potential bidders in the process) (2) Transparency procurement process (process is made open and public) (3) Well-organized and committed public agency	Government guarantee (1) Government involvement by providing a guarantee (2) Multibenefit objectives
4	Stable political and social environment (1) Political support (2) Social support (3) Strong and good private consortium (4) Good governance	Favorable economic conditions (1) Stable macroeconomic conditions (2) Sound economic policy
5	Judicious government control (1) Government involvement by providing guarantee	Available financial market (1) Suitable and adequate financial market

^aLi et al. (2005).

Conclusions

This paper has presented the findings from a questionnaire survey conducted in China (including Hong Kong) looking at the 18 previously identified CSFs for PPP. The FA technique was used to identify the underlying cluster of CSFs. The findings showed that five underlying grouped factors accounting for 68% of the variance in responses were derived from the 18 CSFs. All loadings for the CSFs were greater than 0.5 indicating a high absolute value for each. The factor loading also showed that the underlying grouped factor is positively correlated to the criticality of individual factors of PPP and vice versa.

Since PPP is at a germinating stage of development in China, a study of the CSFs should enable a better understanding of the important individual factors affecting the success or otherwise of PPP projects. It should pave the way for enhanced decision-making in the choice of suitable projects (for which the CSFs can be ensured or controlled in some way) and in the effective management of those already embarked upon. Corresponding effective strategies based on those CSFs identified can also be generated for successfully delivering future PPP projects for accelerated excellence. It is believed that this paper has helped to depict the perspectives of mainland PPP experts in their evaluation of CSFs for PPP projects in China.

Nevertheless, readers must take into consideration that there will be continuous evolution of the PPP project procurement process from the time of data collection and the time of paper publication. It is anticipated that the CSFs within the underlying group stable macroeconomic environment will be affected most due to the prevailing rapid changes to the global financial climate.

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References

- Abdul-Rashid, A. A., Puteri, S. J. K., Ahmed, U. A., and Mastura, J. (2006). "Public private partnerships (PPP) in housing development: The experience of IJM Malaysia in Hyderabad, India." *Proc., Accelerating Excellence in the Built Environment*, Univ. of Wolverhampton, Birmingham, U.K.
- Akintoye, A. (2000). "Analysis of factors influencing project cost estimating practice." *Constr. Manage. Econom.*, 18(1), 77–89.
- Akintoye, A., Beck, M., Hardcastle, C., Chinyio, E., and Asenova, D. (2001). "The financial structure of private finance initiative projects." *Proc., 17th ARCOM Annual Conf.*, Salford University, Manchester, U.K., 361–369.
- Asian Development Bank. (2005). "Technical assistance People's Republic of China: Application of public-private partnerships in urban railbased transportation project." *Project Number: 39527*, (<http://www.adb.org/Documents/TARs/PRC/39527-PRC-TAR.pdf>) (February 9, 2010).
- Awakul, P., and Ogunlana, S. O. (2002). "The effect of attitudinal differences on interface conflicts in large scale construction projects: A case study." *Constr. Manage. Econom.*, 20(4), 365–377.
- Birnie, J. (1999). "Private finance initiative (PFI)—UK construction industry response." *J. Constr. Procure.*, 5(1), 5–14.
- 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.*, 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, 595–604.
- Field, A. P. (2005). *Discovering statistics using SPSS*, 2nd Ed., Sage, London.
- Fox, P., and Skitmore, M. (2007). "Factors facilitating construction industry development." *Build. Res. Inf.*, 35(2), 178–188.
- Gentry, B. S., and Fernandez, L. O. (1997). "Evolving public-private partnerships: General themes and urban water examples." *Proc., OECD Workshop on Globalization and the Environment: Perspectives from OECD and Dynamic Non-Member Economies*, OECD, Paris, 19–25.
- Grant, T. (1996). "Keys to successful public-private partnerships." *Can. Bus. Rev.*, 23(3), 27–28.
- Hardcastle, C., Edwards, P. J., Akintoye, A., and Li, B. (2005). "Critical success factors for PPP/PFI projects in the UK construction industry." *Proc., Conf. on Public Private Partnerships; Opportunities and Challenges*, The Hong Kong Institution of Engineers (Civil Division) and The University of Hong Kong, Hong Kong, 75–83.
- Jamali, D. (2004). "Success and failure mechanisms of public private partnerships (PPPs) in developing countries: Insights from the Lebanese context." *Int. J. Public Sector Management*, 17(5), 414–430.
- Jefferies, M. (2006). "Critical success factors of public private sector partnerships a case study of the Sydney SuperDome." *Eng., Constr., Archit. Manage.*, 13(5), 451–462.
- Jefferies, M., Gameson, R., and Rowlinson, S. (2002). "Critical success factors of the BOOT procurement system: Reflections from the Stadium Australia case study." *Eng., Construct., Architect. Manage.*, 9(4), 352.
- Kanter, R. M. (1999). "From spare change to real change." *Harvard Bus. Rev.*, 77(2), 122–132.
- Lam, E. W. M., Chan, A. P. C., and Chan, D. W. M. (2008). "Determinants of successful design-build projects." *J. Constr. Eng. Manage.*, 134(5), 333–341.
- 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. (2005). "Critical success factors for PPP/PFI projects in the UK construction industry." *Constr. Manage. Econom.*, 23, 459–471.
- Ministry of Construction. (2004). "Sample document for the franchised operation of urban water supply, gas supply and waste disposal." Beijing.
- National Treasury PPP Unit of South Africa. (2007). *Public private partnership manual*, (<http://www.treasury.gov.za/organisation/ppp/default.htm>) (June 15, 2007).
- Nijkamp, P., Van der Burch, M., and Vindigni, G. (2002). "A comparative institutional evaluation of public private partnerships in Dutch urban land-use and revitalization projects." *Urban Stud.*, 39(10), 1865–1880.
- Norusis, M. J. (2008). *SPSS 16.0 advanced statistical procedures companion*, Prentice-Hall, Upper Saddle River, N.J.
- Pett, M. A., Lackey, N. R., and Sullivan, J. J. (2003). *Making sense of factor analysis: The use of factor analysis for instrument development in health care research*, Sage, Thousand Oaks, Calif.
- Proverbs, D. G., Holt, G. D., and Olomolaiye, P. O. (1997). "Factor influencing the choice of concrete supply methods." *Build. Res. Inform.*, 25(3), 176–184.
- Qiao, L., Wang, S. Q., Tiong, R. L. K., and Chan, T. S. (2001). "Framework for critical success factors of BOT projects in China." *Journal of Project Finance*, 7(1), 53–61.
- Sato, T. (2005). *Factor analysis in personality psychology*, (<http://webpace.ship.edu/tosato/factanal.htm>) (May 28, 2008).
- Statistical Package for Social Sciences (SPSS) users' guide. (1997). Prentice-Hall, Upper Saddle River, N.J.
- Statistical Package for Social Sciences (SPSS). (2003). *How to get more value from your survey data—Discover four advanced analysis techniques that make survey research more effective—Technical report*, (<http://www.spss.com/no/products/spssdimensions/morevalue.pdf>) (Apr. 24, 2008).
- Tam, C. M., Li, W. Y., and Chan, A. P. C. (1994). "BOT applications in the power industry of South East Asia: A case study in China. In East meets West." *Procurement Systems Symposium CIB W92 Proceedings Publication 175*, CIB, Hong Kong, 315–322.
- Tiong, R. L. K. (1996). "CSFs in competitive tendering and negotiation model for BOT projects." *J. Constr. Eng. Manage.*, 122(3), 205–211.
- United Nations Economic Commission for Europe. (2007). "A guide to promoting good governance in public private partnerships." *Proc., Int. Conf. on Knowledge Sharing and Capacity Building on Promoting Successful Public Private Partnerships in the UNECE Region*, (http://www.unescap.org/ttdw/common/TPT/PPP/text/guide_good_governance.pdf) (February 9, 2010).
- Wong, A. (2007). "Lessons learned from implementing infrastructure PPPs—A view from Singapore." *Proc., Seminar jointly organized by the Department of Civil Engineering of The University of Hong Kong and Civil Division of The Hong Kong Institution of Engineers*, The University of Hong Kong and The Hong Kong Institution of Engineers, Hong Kong.
- Zhang, X. Q. (2005). "Critical success factors for public-private partnerships in infrastructure development." *J. Constr. Eng. Manage.*, 131(1), 3–14.