Concessionaire's Financial Capability in Developing Build-Operate-Transfer Type Infrastructure Projects

Xueqing Zhang, M.ASCE[1]

Abstract: The concessionaire of a build-operate-transfer (BOT) type infrastructure project undertakes many responsibilities, and consequently, assumes a broad scope of risks and potential financial consequences. In addition, appropriate financial engineering skills are required in nonrecourse or limited-recourse financing, which is usually used in BOT-type projects. Therefore, strong financial capability of the concessionaire is an important prerequisite to the successful development of a BOT-type project. A common set of 35 financial criteria has been identified through a systematic research approach, and their relative significances determined based on worldwide expert opinions solicited by a structured questionnaire survey. Statistical analyses of the responses to the survey conclude that (1) the public, private, and academic sectors consider financial criteria rather similarly in the evaluation of the concessionaire's financial capability, and there is no significant statistical difference in the rating of the significances of the 35 financial criteria across these sectors; (2) almost all of the 35 financial criteria are important in measuring the concessionaire's financial capability; and (3) the 35 financial criteria can be grouped to measure the concessionaire's financial capability in four dimensions: "strong financial engineering techniques," "advantageous finance sources and low service costs," "sound capital structure and requirement of low-level return to investments," and "strong risk management capability." Outputs of this research facilitate the private sector in assessing their financial capability and making corresponding improvements to increase their financial competitiveness, and the public sector in evaluating potential concessionaires' financial capability for BOT projects in general.

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Introduction

Different types of public-private partnerships (PPPs) have been practiced in worldwide infrastructure development in order to achieve the best outputs by mobilizing private-sector funds, technologies, managerial skills, and operational efficiency and by facilitating innovations by transferring more risks and responsibilities from the public sector to the private sector. The build-operate-transfer (BOT) type project procurement methodology underlies various scenarios of PPPs (Zhang and Kumaraswamy 2001).

In addition to the construction task undertaken by a contractor in a traditional design-bid-build contract, the concessionaire in a BOT-type project is also responsible for the design, finance, and operation of the project for a long-term concession period (e.g., the Channel Link project has a concession of 50 years). There is a wide range of risks and uncertainties related to a BOT-type project in the long concession period (Delmon 2000; Askar and Gab-Allah 2002; Schaufelberger and Wipadapisut 2003). The occurrence of one or more of these risks can lead to serious financial consequences to the concessionaire, which may fail the project. Furthermore, the project company of a BOT-type project is usually a special-purpose vehicle (distinct legal entity) using nonrecourse or limited-recourse financing, and this requires appropriate financial engineering techniques. Therefore, a strong financial capability of the concessionaire is essential prior to the successful development of a BOT-type project.

This research aims to (1) explore the key dimensions of the concessionaire's financial capability as required by a general BOT-type infrastructure project, and to (2) identify important criteria that measure each of these dimensions. A systematic approach has been taken. First, 35 criteria (hereafter referred to as financial criteria) that measure the concessionaire's financial capability for a general BOT-type infrastructure project have been identified through literature review, case studies of PPP practices in both developing and developed countries, and interviews/correspondence with experts and practitioners in international PPPs for infrastructure development. Second, a structured questionnaire survey is carried out to solicit worldwide expert opinions of the significances of these financial criteria. Third, statistical analyses (such as factor analysis, agreement analysis, and validity and reliability analysis) have been conducted to verify two hypotheses: (1) The 35 identified financial criteria are important criteria to measure a concessionaire's financial capability, and (2) the 35 financial criteria can be grouped to measure different dimensions of the concessionaire's financial capability.

Outputs of this research facilitate the private sector in assess-

[1]Professional Engineer, Yellow River Conservancy Committee, Ministry of Water Resources of China, 11 Jinshui Rd., Zhengzhou 450003, China.

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ing their financial capability, making relevant improvements to increase their financial competitiveness in the development of BOT-type projects; and the outputs facilitate the public sector in evaluating a potential concessionaire's financial capability by tailoring these financial criteria and making appropriate adjustments to reflect the characteristics of a particular BOT-type project.

Build-Operate-Transfer-Type Infrastructure Projects

Build-Operate-Transfer

A BOT-type infrastructure project can be described as a project based on a concession granted to a consortium (the concessionaire) that is usually from the private sector by a client that is usually a public organization, where the concessionaire makes financial arrangements to "build" the facilities of the project, "operate" the project during the concession period to generate revenues for debt repayment and investments recovery with a certain level of profit, and "transfer" the facilities of the project in operational condition and usually at no cost to the client at the end of the concession period. In a BOT-type project, the concessionaire is responsible for financing, building, and operating the project. Even if the client is also the service user, it usually pays for the service instead of financing the infrastructure (Delmon 2000).

Nonrecourse or Limited-Recourse Financing

BOT-type projects usually use a nonrecourse or limited-recourse financing structure, where lenders look primarily to the revenue stream generated by the project for repayment and to the assets of the project as collateral for the loan. The lenders have no recourse or only limited recourse to the general funds or assets of the project sponsors because the concessionaire is a special-purpose vehicle, in which project assets, project-related contracts, and project cashflows are segregated to a substantial degree from the sponsoring entities. This special-purpose vehicle allows the investors to reduce substantially both their financial investments by using debts and, consequently, their exposure to project liability (Merna and Dubey 1998).

Build-Operate-Transfer-Type Projects

The term *BOT* has generated a string of related acronyms that reflect variations in different industrial sectors: BBO (buy-build-operate), BLT (build-lease-transfer), BOO (build-own-operate), BOOM (build-own-operate-maintain), BOOT (build-own-operate-transfer), BTO (build-transfer-operate), DBFO (design-build-finance-operate), DBOM (design-build-operate-maintain), DOT (develop-operate-transfer), ROO (rehabilitate-own-operate), ROT (rehabilitate-operate-transfer), and TOT (transfer-own-transfer) (Zhang and Kumaraswamy 2001). In this paper, these projects are called, in general, BOT-type projects.

Concessionaire's Financial Capability

Broad Scope of Risk Exposure

In a BOT-type project, the responsibilities of finance, build, design, and operation are integrated on a single source point, the concessionaire. BOT is a highly complex and commercially driven process in which the concessionaire enters into contracts with various project participants, including the client, investors/shareholders, lenders, main contractor(s), main designer(s), insurers, material/equipment suppliers, operator/maintainer, and intermediate/end product/service purchasers.

The concessionaire in a BOT-type project assumes a much broader scope of risks than a mere contractor in a traditional design-bid-build contract. Delmon (2000) and Fitzgerald (1998) provide detailed discussion of the risks undertaken by the concessionaire. These include development risk, completion risk (construction, commissioning, and time for completion), cost-increase risk (currency risk, inflation, taxes, input price increase, construction cost increase, operation cost increase, cost of spare and replacement parts, and decrease in output price), performance risk (design and construction, operation, input supply, and offtake purchaser infrastructure), operation risk (design defects, availability of labor and materials, changes in operating requirements, and cost of asset replacement and major maintenance), market risk (output price and input cost), political risk (enabling legislation, change in budget, government or political atmosphere, expropriations, change of law or taxation, and public perception), environment risk, and credit risk of project participants.

Financial Consequences of Risks

The above-mentioned wide range of risks may result in substantial financial consequences to the concessionaire. Fitzgerald (1998) discusses possible measures to mitigate these risks. Some risks, their possible financial consequences, and mitigation measures are listed in Table 1.

Concessionaire's Financial Capability

A BOT-type project may fail if the concessionaire is not financially sound and/or does not have a strong financial engineering capability to deal with serious financial consequences and exploit financial opportunities as well. Financial engineering is defined as a process by which an organization creatively designs its financial structure and transactions in order to maximize the organization's effectiveness. The concessionaire needs to formulate and implement innovative financial instruments and processes to meet the specific requirements of a particular BOT-type project; these may include modeling and forecasting financial markets, hedging financial risks, investment management, asset/liability management, structuring of sales/purchase transactions, and simulation of the impacts of various financial or product market scenarios on the revenue streams (Joe 1998; Merna and Smith 1999).

Criteria Measuring Concessionaire's Financial Capability

In view of the many responsibilities undertaken and the broad scope of risks assumed by the concessionaire, and the characteristics of nonrecourse or limited-recourse financing, it can be concluded that a strong financial capability of the concessionaire is an important prerequisite for the successful development of a BOT-type project. This necessitates the exploration of the key common dimensions of a concessionaire's financial capability for BOT-type infrastructure projects in general and the identification of a common set of financial criteria against which these key dimensions are evaluated. The writer has thus identified 35 financial criteria that measure different dimensions of a concessionaire's financial capability based on experience and lessons from international PPP practices, previous studies on critical success

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Table 1. Financial Consequences of Some Risks and the Mitigation Measures

Risks	Possible financial consequences	Risk control measures
Construction cost overruns	(1) Delayed project completion, or no completion at all; (2) delayed loan repayments and increased interest and debt; (3) delayed generation of revenues; and (4) shortened operation period available to the concessionaire	(1) High equity/debt ratio; (2) turnkey contracts by experienced and financially strong contractors; (3) contractor performance bonds/third-party guarantees; and (4) cost estimation by an independent party
Operation risks	(1) Reduced revenues due to increasing operating costs and (2) reduced quantity/quality, and/or reduced prices of products/services	(1) Operation and maintenance contracts by experienced and financially sound operator and (2) performance bonds from the operator
Market risks	Lack of demand for the products/services of the project, including two aspects: quantity and price	(1) Offtake contracts with financially sound purchasers and (2) effective market promotion measures
Currency risks	(1) Depreciation in loan currencies increases costs of construction items sourced offshore, and (2) depreciation in the revenue currencies reduces the value of revenues in the operation period	(1) Match the currencies of the sales contracts with the currencies of supply contracts; (2) denominate the loan in the most relevant foreign currency; (3) use suitable foreign currency hedging contracts; (4) establish an offshore account; (5) obtain government support/guarantees on preferential access of the project to foreign exchange, conversion, and transfer; and (6) index the purchase price of the output to inflation or to fluctuations in the exchange rate
Regulatory/ approvals risks	(1) Long time to get government licenses and approvals; (2) project is subject to excessive taxation; (3) royalty payments; and (4) rigid local supply or distribution requirements	(1) Obtain host government guarantees on various approvals/ permits and (2) obtain government support regarding taxation, royalty payments, and local supply/distribution

factors for PPPs, and evaluation criteria used in worldwide PPP projects. For details on how these criteria are developed, please refer to Zhang (2004). Brief descriptions of these criteria appear in Table 2.

Hypotheses and Verification Process

Hypotheses

Hypothesis 1: The 35 financial criteria are important criteria to measure a concessionaire's financial capability.

The significance of a financial criterion is measured on a scale of 0–5 (with 0 being "not applicable," 1 being "not significant," 2 being "fairly significant," 3 being "significant," 4 being "very significant," and 5 being "extremely significant"). A financial criterion is "important" if it is at a significance level equal to or greater than 3.

Hypothesis 2: The 35 criteria can be grouped to measure different dimensions of a concessionaire's financial capability.

Verification Process

To verify the two hypotheses, two main steps have been followed.

Step 1: Determining the significances of the 35 financial criteria through a structured questionnaire survey of opinions of worldwide experts, practitioners, and researchers from public, private, and academic sectors.

Step 2: Systematic statistical analyses of the survey responses using the SPSS package and Microsoft Excel. These include

1. Kaiser-Meyer-Olkin (KMO) test to examine the sampling adequacy of the questionnaire survey
2. Factor analysis to derive the key dimensions of a concessionaire's financial capability and to identify their respective measuring criteria
3. Validity analysis (Pearson bivariate correlations) and reliability analysis (Cronbach alpha) to examine the quality of the questionnaire survey and the soundness of the factor analysis
4. Mann Whitney U test and comparison of mean significance indexes as rated by each sector to determine the agreement level in the rating of the significances of the financial criteria across the public, private, and academic sectors
5. Analysis of the significances of the financial criteria to identify the most important ones in different dimensions of a concessionaire's financial capability

Questionnaire Survey on Significances of Financial Criteria

To determine the relative significances of the financial criteria, a structured questionnaire survey of international expert opinions was carried out from December 2000 through May 2001. Here, the "expert" is defined as a person who has been actively involved in the procurement of at least one PPP project and/or has done substantial research in the procurement of PPP projects. In this survey, respondents were asked to indicate the significances of the financial criteria on a scale of 0–5, as mentioned above. Forty-six respondents returned complete questionnaires. They were from 42 different organizations/institutions in a number of countries and regions, including Australia, Hong Kong Special Administrative Region of China, India, Japan, Peru, the Philippines, Mainland China, Malaysia, Singapore, South Africa, Thailand, U.K., and USA. Twelve respondents were from public clients, 17 from private companies, and 17 from academia. Many of the respondents were from organizations that had rich experience, knowledge, and expertise in PPPs—for example, the Asian Development Bank, Essex County Council (U.K.), Department for International Development (U.K.), Gammon Construction Ltd. (Hong Kong), Highways Department (Hong Kong), International Finance Corporation, Manchester City Council (U.K.), Nishimatsu Construction Co. Ltd. Hong Kong Branch, Partnerships UK, the Philippine BOT Center, Public-Private Partnership Unit of the Ministry of Defense (U.K.), Schools Private Finance Team of the Department for Education and Employment (U.K.), Southern Energy Asia-

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Table 2. Financial Criteria and Remarks

Financial criteria	Remarks
Sound financial analysis	This refers to the overall financial analysis: whether all important financial aspects have been analyzed adequately
Total investment schedule	This refers to the schedule of all financial sources (including equity and debt) and their combination in the development of the project
Payment and drawdown schedule	This refers to the drawdown and payment of debt from different sources
Equity/debt ratio	Higher equity level means increased capability of the concessionaire to overcome financial difficulties and its higher commitment to project success
Sources and structure of main loans	Sources of loans, fixed or variable interest rates, and the way loans are repaid (equal repayment, equal payments and a final balloon payment, interest-only repayment schedule with a final balloon payment, one payment at a specified date, including the principal and accrued interest, or equal principal payments each period)
Sources and structure of stand-by financing facilities	Stand-by financing facilities are prepared for possible future eventualities
Attractiveness of main loan agreement	This refers to the terms of the main loan agreements, which determine the costs of the man loans
Attractiveness of stand-by loan agreement	This refers to the terms of stand-by loan agreements, which determine the costs of the stand-by loans
Attractiveness of shareholder agreement	Shareholder agreement outlines the duties, responsibilities, and benefits of each shareholder and sets forth restrictions on the transfer of shares to a third party
Low financial service charges	Extensive financial services are required in a BOT project; service charges constitute a substantial part of the total project cost
Fixed and low interest rate financing	This to some extent minimizes financial risks and reduces project costs as interests may constitute a substantial part of the total project costs
Long-term loan financing and minimizing refinancing risk	A BOT project needs to establish market and increase revenues over time; long-term loan avoids the repayment pressure in the initial period of the project's operation and minimizes refinancing risks, and thus avoids possible serious financial consequences
Abilities to deal with fluctuations in interest/exchange rates	Fluctuations in interest and exchange rates can seriously affect the project's cash flows, which in turn affect its feasibility
Creative financial packages	This refers to the creative use of financial methods and instruments to structure the BOT project and its transactions
Local financing	This reduces foreign currency risks (e.g., convertibility and fluctuation of exchange rate)
Ability of the concessionaire to get supplementary external financing	Supplementary external financing helps overcome the problem of cost overruns and weak revenues
Currencies of loans and equity finance	This affects the cash flow and in turn affects the viability and profitability of the project
Currency of revenues and payments	This affects the cash flow and in turn affects the viability and profitability of the project
Financiers' abilities (especially the leading bank's)	Financiers play an important role in financial evaluation and financial engineering of the project
Minimal financial risks to the client	One purpose of the public client to develop BOT-type projects is to transfer risks to the private sector that is better equipped to manage them
Internal rate of return to equity	This reflects the profit level of the equity investment
Net present value of toll/tariff revenues in the concession period	This measures the total cost to the public for using the services or products of the project in the concession period
Tariff/toll setting up and adjustment mechanism	This determines the cost of service/product to the public and affects the overall pricing system of public works and services
Low toll/tariff levels	This means low service/product costs to the public
Government's control on tolls/tariffs	High levels of tolls/tariffs can lead to public opposition, which is a high political cost to the government organization
Schedule of revenues	Revenues distribution can affect the normal operation of the project; contingencies should be made for possible risks in different areas
Financial strength of the participants in the project company	A project participant's ability to do a quality job depends to some degree on its financial strength
Strong financial commitments from shareholders	This ensures funds and management efforts for possible financial problems in the concession period
Construction period	Short construction period means early availability of service/product to the public, and possibly, reduced project development costs

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Table 2. (*Continued.*)

Financial criteria	Remarks
Concession period	Other things being the same, short concession period means low total costs to the public client
Financial institution guarantees	This refers to the providing of main loans and stand-by loans, and their structure
Insurance cover	This refers to the insurance arrangement against various types of risks
Sharing of profits with the client	This actually reduces the service/product costs to the public, as the public client can use the shared profit to serve the public
Less financial guarantee required from the client	This reduces the financial risks of the public client in the development of the project
Ability to address commercial risk (e.g., supply and demand risks)	The commercial risk can seriously affect the cash flow of the project, which in turn affects the debt repayment and the project's normal operation

Note: BOT=Build-operate-transfer.

Pacific Ltd. (Hong Kong), Transport Department (Hong Kong), and the World Bank.

Factor Analysis of Financial Criteria

Concept and Steps of Factor Analysis

Factor analysis is a statistical approach that can be used to verify the conceptualization of a hypothesis (construct) by analyzing interrelationships among a large number of variables, and to explain these variables in terms of their common underlying dimensions (factors) by condensing the information contained in a number of original variables into a smaller set of dimensions (factors) with a minimum loss of information. Factor analysis can also be used to determine the relative importance among these dimensions. There are four basic steps for factor analysis [please refer to Zeller and Carmines (1980); George and Mallery (2000); and Pett et al. (2003) for details]:

1. Generation of the correlation matrix
2. Extraction of initial factors
3. Rotation and interpretation
4. Construction of scales or factor scores for further analyses

Adequacy for Factor Analysis

The survey data should be examined to see whether it is appropriate to use factor analysis by conducting the KMO test and/or the Bartlett's test of sphericity. The two tests provide a minimum standard that should be passed before a factor analysis is conducted. Varying between 0 and 1, the KMO measures the sampling adequacy. The KMO value should be greater than 0.6 for a satisfactory factor analysis to proceed. In the case discussed in this paper the KMO value is 0.897, indicating that the data are adequate for factor analysis. The Bartlett's test of sphericity tests the null hypothesis that the correlation matrix is an identity matrix. This null hypothesis should be rejected before proceeding the factor analysis.

Components Extracted

In this paper, the principal components are used to extract highly correlated financial criteria into a small number of key components (dimensions) of the concessionaire's financial capability. The principal components are extracted by specifying eigenvalues greater than a specific value. Eigenvalues are the variances of the principal components. There are two main results from the factor analysis: (1) total variance explained by the extracted components (Table 3), and (2) the rotated component matrix (Table 4).

Here, a minimum initial eigenvalue of 1.9 is used in the extraction of four components (i.e., four key dimensions of a concessionaire's financial capability). In Table 3, the "Total" column contains the eigenvalues. The "% of variance" column contains the percentage of variance accounted for by each extracted component. The "cumulative %" column contains the cumulative percentage of variance accounted for by the current and all preceding components. The four extracted components cumulatively explain 66.131% of the total variance.

Fig. 1 shows the scree plot of the factor analysis. The scree plot graphs the eigenvalue against the number of components. It is seen that the line is almost flat from the fifth component on, indicating that each successive component accounts for decreasing amounts of the total variance. The four components whose eigenvalues are greater than 1.9 are kept, while other components with an eigenvalue of less than 1.9 are dropped.

In Table 4, each row contains component loadings, the correlations between the variable (the financial criteria) and the component. The component loadings indicate which criteria belong to which component. The first component that has the

Table 3. Total Variance Explained by Extracted Components

	Extraction sums of squared loadings			Rotation sums of squared loadings		
Component	Total	Percentage of variance	Cumulative (%)	Total	Percentage of variance	Cumulative (%)
1	14.050	40.142	40.142	6.852	19.576	19.576
2	4.602	13.149	53.291	5.928	16.938	36.514
3	2.585	7.386	60.677	5.242	14.978	51.492
4	1.909	5.454	66.131	5.124	14.639	66.131

Table 4. Rotated Component Matrix

Financial criteria	Component 1	2	3	4
Sound financial analysis			0.678	
Total investment schedule	0.633			
Payment and drawdown schedule		(0.422)		
Equity/debt ratio			0.541	
Sources and structure of main loans			0.764	
Sources and structure of stand-by financing facilities				(0.486)
Attractiveness of main loan agreement		0.603		
Attractiveness of stand-by loan agreement		0.595		
Attractiveness of shareholder agreement			(0.496)	
Low financial charges		0.913		
Fixed and low interest rate financing	0.640	0.668		
Long-term loan financing and minimizing refinancing risk	0.652			
Abilities to deal with fluctuations in interest/exchange rates				0.575
Creative financial packages	0.623	0.599		
Local financing	0.609			
Ability of the concessionaire to get supplementary external financing				0.537
Currencies of loans and equity finance			0.526	0.578
Currency of revenues and payments	0.634			
Financiers' abilities (especially the leading bank's)			0.701	
Minimal financial risks to the client				
Internal rate of return to equity			0.696	
Net present value of toll/tariff revenues in the concession period			0.815	
Tariff/toll setting up and adjustment mechanism	0.761			
Low toll/tariff levels		0.849		
Government's control on tolls/tariffs				0.752
Schedule of revenues				0.724
Financial strength of the participants in the project company				0.693
Strong financial commitments from shareholders	0.689			
Construction period		0.691		
Concession period			0.708	
Financial institution guarantees	0.670			
Insurance cover	0.734			
Sharing of profits with the client				0.669
Less financial guarantee required from the client				0.522
Ability to address commercial risk (e.g., supply and demand risks)	0.638			

largest variance (i.e., contains the maximum information in all criteria) can explain the problem most effectively. The second component is independent of the first component and contains as much of the remaining information in all criteria as possible, and so on.

In order to develop a clear pattern, orthogonal rotation of the principal components is performed using the varimax method to modify factor loadings so that their new values are close to −1, 1, or 0. This makes it easier to group criteria that have a factor loading close to −1 or 1 on a single component and those with small factor loadings (close to 0) on the other components. Table 4 is the rotated component matrix, in which, to make the output easier to read, suppressed absolute values less than 0.5 are used to inform SPSS not to print any of the correlations that are 0.5 or less.

As shown in Table 4, the 35 financial criteria are grouped into four components, which, after examination of the meanings of their measuring criteria, are renamed as "strong financial engineering techniques," "advantageous financing sources and low

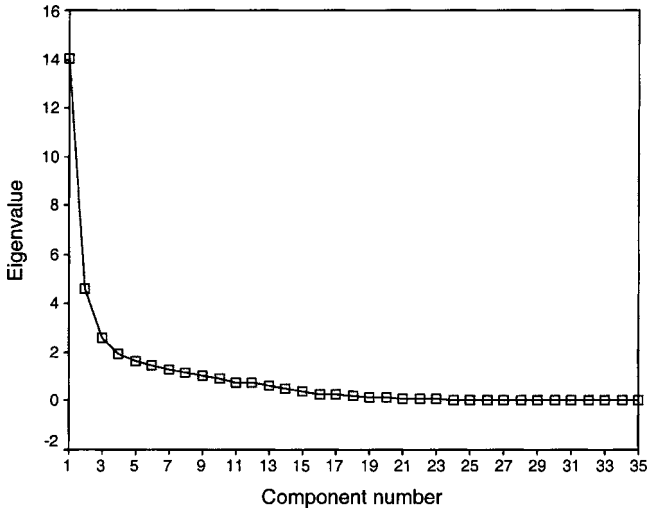

Fig. 1. Scree plot for the factor analysis

service costs," "sound capital structure and requirement of low-level return to investments," and "strong risk management capability." The criteria measuring each dimension of the concessionaire's financial capability are listed in Table 8.

Validity and Reliability

Validity

Validity analysis examines whether what is expected to be measured is measured. This means that, if the criteria grouped in a particular component collectively explain the concessionaire's capability in that dimension, they should significantly correlate with one another. Here, Pearson bivariate correlation analysis is conducted to examine whether relationships between these criteria exist to ensure validity. According to the Pearson's table, the critical values that need to be surpassed to achieve significance for the two-tailed test for a sample of size 46 are around 0.288 and 0.372 for the 0.05 level and 0.01 level, respectively. Table 5 shows the correlations between criteria grouped in component I ("strong financial engineering techniques"). These results ensure that all criteria that measure a specific dimension of the concessionaire's financial capability are correlated.

Reliability

The internal consistency is examined to ensure at a certain level that the scale (0–5) for measuring financial criteria yields the same result over time. This aims at finding the reliability coefficient based on the average correlation among criteria and on the number of criteria. Cronbach alpha is performed to test the internal consistency reliability of the criterion scale. As a reliability coefficient, the value of Cronbach alpha varies from 0 to 1; the higher the value is, the greater the internal consistency reliability. The value of Cronbach alpha is inflated by a large number of variables, so there is no set interpretation as to what is an acceptable value. A rule of thumb that applies to most situations is as follows (George and Mallery 2000):

$$\text{Alpha} > 0.9 \text{ — excellent}$$

$$\text{Alpha} > 0.8 \text{ — good}$$

$$\text{Alpha} > 0.7 \text{ — acceptable}$$

$$\text{Alpha} > 0.6 \text{ — questionable}$$

$$\text{Alpha} > 0.5 \text{ — poor}$$

$$\text{Alpha} < 0.5 \text{ — unacceptable}$$

Table 6 shows the values of Cronbach alpha for criteria that measure different dimensions of the concessionaire's financial capability, as well as that for all criteria. The results indicate good internal consistency reliability of the financial criteria.

Agreement Analysis

Mann Whitney U Test

The Mann Whitney U test (George and Mallery 2000) is a nonparametric test used to compare two independent groups of sampled data. The statistic of this test is U, which is compared to a table of critical values based on the sample size of each group. Here, the Mann Whitney U test is conducted to determine whether the mean significance of each financial criterion is equal across the public, private, and academic sectors. The hypotheses for the comparison of two of the three independent sectors are these:

H_o: The mean significance of each financial criterion is equal between two sectors

H_a: The mean significance of each financial criterion is different between two sectors

If the U value exceeds its critical value at some significance level (usually 0.05), it means that there is evidence to reject the null hypothesis and accept the alternative hypothesis. The test results are summarized in Table 7, where U values that are less than 0.05 are highlighted in bold text. It is seen that only four out of the 35 criteria (11%) are indicated as statistically different—namely, "local financing," "ability of the concessionaire to get supplementary external financing," "minimal financial risks to the client," and "schedule of revenues." This means that the public, private, and academic sectors consider financial criteria rather similarly (89%) in the evaluation of the concessionaire's financial capability.

Comparison of Mean Significance Index and Ranking Order across Sectors

As shown in Table 8, the level of agreement across the public, private, and academic sectors in the rating of the significances of the financial criteria is analyzed by comparing the mean significance indexes and the ranking orders as evaluated by each sector.

For criteria grouped in component I, all are rated as being greater than 3 ("significant") by all sectors except for "local financing," which is rated at 2.8 (close to "significant") overall and at 2.08 (between "fairly significant" and "significant") by the private sector. Overall, the top three most important criteria are "tariff/toll setting up and adjustment mechanism," "ability to address commercial risk," and "total investment schedule." The academic sector also rates these three criteria as the top three most significant in exactly the same order. The public and private sectors agree with the academic sector in ranking two of these three criteria among the top three. However, the public and private sectors rank "strong financial commitments from shareholders" as one of the top three.

For criteria grouped in component II, the three sectors rank them in almost exactly the same order. All are rated as being greater than or equal to 3 ("significant"), except for "construction period," which is rated at 2.8 (close to "significant") overall, at 2.57 (between "fairly significant" and "significant") by the private sector, and at 2.75 (close to "significant") by the academic sector.

For criteria grouped in component III, overall, all are rated at a significance level higher than "significant" (greater than 3), except for "currencies of loans and equity finance," which is rated at 2.95 (very close to "significant"). Overall, the top three criteria are "sound financial analysis," "net present value of tariff/toll revenues in the concession period," and "internal rate of return to

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Table 5. Correlations of Financial Criteria in Component I

Criteria	Total investment schedule	Fixed and low interest rate financing	Long-term loan financing and minimizing refinancing risk	Creative financial packages	Local financing	Currency of revenues and payments	Tariff/toll setting up and adjustment mechanism	Strong financial commitments from shareholders	Financial institution guarantees	Insurance cover	Ability to address commercial risk (e.g., supply and demand risks)	Payment and drawdown schedule
Total investment schedule	1.000											
Fixed and low interest rate financing	0.469[a]	1.000										
Long-term loan financing and minimizing refinancing risk	0.649[a]	0.715[a]	1.000									
Creative financial packages	0.319[b]	0.766[a]	0.715[a]	1.000								
Local financing	0.495[a]	0.520[a]	0.473[a]	0.398[a]	1.000							
Currency of revenues and payments	0.497[a]	0.650[a]	0.708[a]	0.563[a]	0.621[a]	1.000						
Tariff/toll setting up and adjustment mechanism	0.404[a]	0.587[a]	0.432[a]	0.600[a]	0.567[a]	0.549[a]	1.000					
Strong financial commitments from shareholders	0.456[a]	0.593[a]	0.491[a]	0.719[a]	0.606[a]	0.603[a]	0.776[a]	1.000				
Financial institution guarantees	0.556[a]	0.794[a]	0.759[a]	0.732[a]	0.510[a]	0.672[a]	0.562[a]	0.700[a]	1.000			
Insurance cover	0.634[a]	0.458[a]	0.394[a]	0.400[a]	0.536[a]	0.508[a]	0.490[a]	0.681[a]	0.691[a]	1.000		
Ability to address commercial risk (e.g., supply and demand risks)	0.328[b]	0.589[a]	0.598[a]	0.612[a]	0.426[a]	0.679[a]	0.618[a]	0.541[a]	0.618[a]	0.416[a]	1.000	
Payment and drawdown schedule	0.493[a]	0.479[a]	0.327[b]	0.394[a]	0.453[a]	0.260	0.323[b]	0.370[b]	0.500[a]	0.535[a]	0.444[a]	1.000

[a]Correlation is significant at the 0.01 level (2-tailed).

[b]Correlation is significant at the 0.05 level (2-tailed).

Table 6. Reliability Analysis

Criteria	Cronbach alpha
Criteria in Component I	0.9313
Criteria in Component II	0.8250
Criteria in Component III	0.8726
Criteria in Component IV	0.8302
All criteria	0.9482

equity." The private and academic sectors also rank the three criteria as the top three, while the public sector ranks "concession period" as one of the top three. All criteria are rated at a significance level equal to or higher than "significant" (greater than 3) by each sector, except for "currencies of loans and equity finance," which is rated at 2.82 (close to "significant") by the public sector, and "attractiveness of shareholder agreement," which is rated at 2.64 (between "fairly significant" and "significant") by the private sector.

For criteria grouped in component IV, overall, all are rated as being "significant" or on a higher level of significance (equal to or greater than 3). Overall, the top three criteria are "minimal financial risks to the client," "financial strength of the participants in the project company," and "government's control on tariffs/tolls." The private and academic sectors rank two of these three criteria among the top three, while the public sector ranks only one of them as the top three. Both public and academic sectors rank "schedule of revenues" as one of the top three criteria. The private sector ranks "less financial guarantee required from the client" as number 2, while the public sector ranks "abilities to deal with fluctuations in interest/exchange rates" as number 2. All criteria

Table 7. Mann Whitney U Test Results

	Between public and private sectors		Between public and academic sectors		Between private and academic sectors	
Criteria	Asymp. Sig. (2-tailed)	Exact Sig. [2[a](1-tailed Sig.)]	Asymp. Sig. (2-tailed)	Exact Sig. [2[a](1-tailed Sig.)]	Asymp. Sig. (2-tailed)	Exact Sig. [2[a](1-tailed Sig.)]
Sound financial analysis	0.262	0.344	0.854	0.904	0.255	0.334
Total investment schedule	0.052	0.061	0.315	0.368	0.172	0.202
Payment and drawdown schedule	0.280	0.305	0.797	0.827	0.265	0.299
Equity/debt ratio	0.112	0.134	0.956	0.959	0.060	0.072
Sources and structure of main loans	0.585	0.609	0.436	0.481	0.965	0.984
Sources and structure of stand-by financing facilities	0.146	0.183	0.177	0.212	0.879	0.886
Attractiveness of main loan agreement	0.793	0.809	0.847	0.865	0.947	0.951
Attractiveness of stand-by loan agreement	0.078	0.095	0.170	0.212	0.480	0.525
Attractiveness of shareholder agreement	0.163	0.202	0.872	0.904	0.172	0.193
Low financial charges	0.707	0.723	0.132	0.165	0.304	0.338
Fixed and low interest rate financing	0.937	0.942	0.978	0.981	0.904	0.926
Long-term loan financing and minimizing refinancing risk	0.816	0.851	0.679	0.716	0.982	0.984
Abilities to deal with fluctuations in interest/exchange rates	0.530	0.572	0.289	0.368	0.171	0.208
Creative financial packages	0.572	0.609	0.801	0.838	0.415	0.451
Local financing	0.060	0.072	0.979	0.981	**0.025**	**0.028**
Ability of the concessionaire to get supplementary external financing	0.285	0.317	0.103	0.134	**0.047**	0.058
Currencies of loans and equity finance	0.859	0.893	0.284	0.318	0.339	0.377
Currency of revenues and payments	0.547	0.566	0.379	0.422	0.943	0.945
Financiers' abilities (especially the leading bank's)	0.422	0.467	0.789	0.827	0.227	0.275
Minimal financial risks to the client	**0.012**	**0.018**	0.073	0.121	0.154	0.240
Internal rate of return to equity	0.453	0.501	0.378	0.422	0.775	0.790
Net present value of toll/tariff revenues in the concession period	0.712	0.760	0.654	0.680	0.418	0.470
Tariff/toll setting up and adjustment mechanism	0.714	0.753	0.609	0.645	0.351	0.402
Low toll/tariff levels	0.141	0.164	0.261	0.294	0.484	0.520
Government's control on tolls/tariffs	0.684	0.721	0.255	0.294	0.538	0.572
Schedule of revenues	**0.047**	0.066	0.164	0.195	**0.002**	**0.002**
Financial strength of the participants in the project company	0.255	0.291	0.569	0.610	0.059	0.085
Strong financial commitments from shareholders	0.103	0.134	0.430	0.481	0.371	0.400
Construction period	1.000	1.000	0.076	0.099	0.095	0.110
Concession period	0.937	0.942	0.834	0.865	0.921	0.926

[a]Not corrected for ties.

Table 8. Average Significance Indexes and Ranking Orders of Financial Criteria Measuring Different Dimensions of Financial Capability

Criteria measuring different dimensions of financial capability	Significance index				Ranking order			
	Overall[a]	Public	Private	Academic	Overall[a]	Public	Private	Academic
(a) Component I—Strong Financial Engineering Techniques								
Tariff/toll setting up and adjustment mechanism	4.14	4.18	4	4.25	1	2	2	1
Ability to address commercial risk (e.g., supply and demand risks)	3.98	3.64	4.07	4.13	2	6	1	2
Total investment schedule	3.81	4.27	3.33	3.94	3	1	5	3
Strong financial commitments from shareholders	3.78	4.09	3.5	3.81	4	3	3	4
Insurance cover	3.57	4	3.33	3.5	5	4	6	8
Financial institution guarantees	3.53	3.73	3.31	3.63	6	5	7	5
Long-term loan financing and minimizing refinancing risk	3.51	3.55	3.36	3.63	7	8	4	6
Fixed and low interest rate financing	3.44	3.55	3.31	3.5	8	9	8	9
Payment and drawdown schedule	3.4	3.64	3.13	3.5	9	7	9	10
Creative financial packages	3.35	3.45	3	3.6	10	10	11	7
Currency of revenues and payments	3.18	3	3.08	3.38	11	12	10	11
Local financing	2.8	3.09	2.08	3.19	12	11	12	12
(b) Component II—Advantageous Financing Sources and Low Service Costs								
Attractiveness of main loan agreement	4.14	4.18	4	4.25	1	1	1	1
Attractiveness of stand-by loan agreement	3.56	3.3	3.47	3.81	2	2	2	3
Low financial charges	3.44	3.27	3	3.94	3	3	3	2
Low tariff/toll levels	3.07	3.18	3	3.06	4	4	4	4
Construction period	2.80	3.18	2.57	2.75	5	5	5	5
(c) Component III—Sound Capital Structure and Requirement of Low-Level Return to Investments								
Sound financial analysis	4.44	4.55	4.21	4.56	1	1	2	1
Net present value of tariffs/tolls revenues in the concessionaire period	4.19	4.27	4.33	4	2	2	1	3
Internal rate of return to equity	3.95	3.73	4	4.06	3	5	3	2
Concession period	3.81	3.82	3.81	3.81	4	3	5	5
Financiers' abilities (especially the leading bank's)	3.76	3.64	4	3.63	5	6	4	6
Equity/debt ratio	3.59	3.82	3.08	3.87	6	4	7	4
Sources and structure of main loans	3.54	3.45	3.57	3.56	7	7	6	7
Currencies of loans and equity finance	3.07	2.82	3	3.31	8	9	8	8
Attractiveness of shareholder agreement	2.95	3.09	2.64	3.13	9	8	9	9
(d) Component IV—Strong Risk Management Capability								
Minimal financial risks to the client	3.95	3.55	4.29	3.94	1	4	1	3
Financial strength of the participants in the project company	3.85	4	3.36	4.19	2	1	4	1
Government's control on tariffs/tolls	3.64	3.45	3.53	3.88	3	5	3	5
Less financial guarantee required from the client	3.6	3.18	3.8	3.69	4	7	2	6
Abilities to deal with fluctuations in interest/exchange rates	3.56	3.64	3.07	3.94	5	2	5	4
Schedule of revenues	3.46	3.64	2.64	4.06	6	3	9	2
Ability of the concessionaire to get supplementary external financing	3.29	3.18	2.93	3.69	7	8	7	7
Sharing of profits with the client	3.22	3.18	3	3.44	8	9	6	8
Sources and structure of stand-by financing facilities	3	3.36	2.86	2.87	9	6	8	9

[a]The average of the public, private, and academic sectors.

are rated at a significance level equal to or higher than "significant" by each sector, except for "schedule of revenues," "sources and structure of stand-by financing facilities," and "ability of the concessionaire to get supplementary external financing," which are rated at 2.64, 2.86, and 2.93, respectively, by the private sector, and for "sources and structure of stand-by financing facilities," that is rated at 2.87 by the academic sector.

Conclusions

The concessionaire in a BOT-type project assumes a broad scope of risks, which, if not properly managed, may result in substantial financial consequences to the concessionaire. The project may fail if the concessionaire does not have a strong financial capability such as skilled financial engineering techniques to deal with these financial consequences and exploit financial opportunities. Therefore, strong financial capability of the concessionaire is an essential prerequisite to the success of a BOT-type project.

Statistical analyses of international expert opinions regarding the significances of the 35 financial criteria that measure a concessionaire's financial capability in developing BOT-type projects provide the following results:

1. The Kaiser-Meyer-Olkin (KMO) test supports the conclusion that the survey data are adequate for factor analysis.

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2. Factor analysis establishes four key dimensions of the concessionaire's financial capability, i.e., "strong financial engineering techniques," "advantageous financing sources and low service costs," "sound capital structure and requirement of low-level return to investments," and "strong risk management capability," and identifies the measuring criteria for each dimension.
3. Validity analysis and reliability analysis confirm the quality of the questionnaire survey, the soundness of the factor analysis, and the internal consistency of the financial criteria in measuring the four dimensions of the concessionaire's financial capability.
4. The Mann Whitney U test shows that the public, private, and academic sectors consider financial criteria rather similarly in the evaluation of the concessionaire's financial capability, and that there is no statistical difference between these sectors in the rating of these financial criteria.
5. Statistical analysis and comparison of the mean significances of the financial criteria as rated by each sector conclude that almost all of the 35 financial criteria are important in measuring the concessionaire's financial capability, and identifies the most important ones in each of the four dimensions.

These outputs facilitate the private sector in assessing their financial capability and making corresponding improvements to increase their financial competitiveness, and the public sector in evaluating potential concessionaires' financial capability for BOT projects in general. This will definitely contribute to the successful development of BOT-type infrastructure projects.

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