Public Clients' Best Value Perspectives of Public Private Partnerships in Infrastructure Development

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Abstract: The multiple objectives of public clients in formulating partnerships with the private sector in infrastructure development and the radical realignment of risks, responsibilities, and awards among project participants in such partnerships necessitate a best value source selection (BVSS) methodology to choose the right private sector partner who assumes far more and much deeper risks than a mere contractor. One critical step in adopting the BVSS is to express the client's objectives in terms of best value contributing factors (BVCFs), against which alternative proposals are evaluated and consequently a sound and defensible contract award decision made. A set of 21 BVCFs in public private partnerships (PPPs) has been identified through literature review of BVCFs in different types of contracts, case studies of worldwide PPP practices, and interviews or correspondence with international PPP experts and experienced practitioners. The relative significance of these BVCFs is statistically analyzed based on a questionnaire survey of worldwide expert opinions. Results show that there is no statistical difference in the rating of these BVCFs between responses from academia and those from industry. Except for four BVCFs that are at a significance level between "fairly significant" and "significant" according to overall, academic, or industrial responses, all other BVCFs are at a significance level greater than "significant." These research outputs facilitate a BVSS process for PPPs in general.

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Introduction

A variety of contract types have been used in the procurement of public works and services. From the traditional design-bid-build (DBB) contract, where the client contracts sequentially with the designer and then with the contractor; to the design-build (DB) contract where the client contracts with a single source, the designer-builder, to design and build a project; and to the build-operate-transfer (BOT) type contract in public private partnerships (PPPs) where the client contracts with the private sector partner, the concessionaire, who is responsible for financing, designing, constructing, and operating during the concession period, and then transferring the built facilities to the client when the contract ends. No matter which contract type is chosen, the selection of the right source (designer, contractor, designer-builder, or concessionaire) is critical to the success of the acquisition. "Lowest price" based source selection is common in both public and private contracts. However, this approach may not necessarily provide the most economical end results or the desired best value. Gransberg and Ellicott (1996, 1997) have discussed the illusion of apparent cost savings through purely price based contractor selection. For example, contractors may seek other means to compensate for unrealistically low bids.

A best value approach has been increasingly used worldwide in the procurement of public works and services, where public clients aim to achieve the maximum outcome from a business transaction. A best value source selection (BVSS) methodology has been used in various types of contracts, where public clients perceive that a multicriterion evaluation (including price) will provide the highest probability of selecting the right source that will give the best offer. This is particularly the case in different types of PPPs in worldwide infrastructure development.

PPPs aim to achieve the best outputs by mobilizing private sector funds, technologies, managerial skills, and operational efficiency and facilitating innovations by transferring more risks and responsibilities to the private sector. The broad range of risks and responsibilities (as listed by Delmon 2000) undertaken by the private sector necessitates a BVSS approach in choosing the appropriate private sector partner in PPPs. In this regard, one critical issue is to identify factors [hereinafter referred to as best value contributing factors (BVCFs)] that contribute to the best value in terms of the public client's general business needs and particular project objectives.

In this research, BVCFs in PPPs have been explored through case studies of international PPP practices. This is supplemented by (1) a literature review of the BVSS approaches and corresponding BVCFs in the DBB, DB, and design-build-operate/maintain (DBO/M) contracts, and (2) interviews and correspondence with worldwide experts/experienced practitioners in diverse public client organizations. The writer has consequently developed a set of 21 BVCFs in PPPs. The relative significance and rankings of these BVCFs have been determined based on a structured questionnaire survey of the opinions of international

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PPP experts and researchers. Agreement analysis has been made in the rankings of the BVCFs between responses from academia and those from industry. Applications of these BVCFs in a BVSS process have also been discussed.

Best Value Approaches

Best Value

The best value approach aims to maximize the outcome of a business transaction. It emphasizes efficiency, value for money, and performance standards. The best value approach requires public sector organizations to establish best practice, develop verifiable standards, and make appropriate contractual arrangements in the procurement of public works and services in order to serve the public in the best possible way (Akintoye et al. 2003).

Best Value Contributing Factors

From public clients' point of view, the best value depends on their objectives, which are constrained by their business requirements (e.g., scope and priorities), available resources (e.g., time, money, and space), and the particular attributes of the specific project under consideration. Value includes tangible, intangible, intrinsic, and extrinsic aspects. Time, cost, image, aesthetics/appearance, operation and maintenance, managerial, safety, and environmental aspects all influence the best value (Gransberg and Ellicott 1997).

BVCFs should be identified at the outset to reflect the client's objectives. For example, in the private finance initiative (PFI) projects in the United Kingdom, BVCFs are derived from the following assessment areas: (1) risk transfer, (2) planning/site considerations, (3) design, (4) redundant premises, (5) consequential risk, (6) occupancy risk, (7) development risk, (8) program, (9) accommodation requirements, (10) facilities management, (11) alternative revenue streams, (12) contract framework, and (13) consortium structure (Blackwell 2000).

Best Value Contracting/Best Value Source Selection

Best value contracting, also called BVSS, aims to maximize the outcome of a business transaction through appropriate contractual arrangements. The U.S. Federal Acquisition Regulation states that public agencies can obtain best value by using one or a combination of source selection approaches. The BVSS allows tradeoffs among price and nonprice factors, and thus enables the public client to select a higher priced proposal instead of the lowest priced proposal, provided that the increased benefits merit the additional cost. For example, the United States Army Material Command (1998) recommends a "price realism analysis" and "cost versus quality" tradeoff analysis for its BVSS process. The relative importance of price and nonprice criteria varies in different types of contracts. Price may play a dominant role in an acquisition where there are clear requirements and risks are minimal. However, nonprice criteria may dominate in an acquisition where the requirements are not well defined, much development work is needed, and/or there are substantial performance risks (Mickaliger 2001). The BVSS encourages creativity and innovation from interested parties in meeting the requirements of a public project and provides the public client flexibility to select a project proposal that offers the best value.

Best Value Perspectives in Different Types of Contracts

Design-Bid-Build Contracts

In DBB contracts, there is limited scope for the best value approach, as contractors are required to tender for a construction work the design of which has already been completed. The "lowest price" is usually the only criterion against which the contractor is selected. To address problems inherent in "lowest price" based contracts, other BVCFs have been taken into consideration for better value for money. One approach is to examine the economic value of the extended warranty period provided by the contractor beyond the (minimum) warranty period after construction completion that is usually stated in the contract. For example, the Maryland Department of Transportation adopts a bid adjustment method for additional period of warranties beyond the stipulated minimum five-year warranty period (Russell et al. 1999; Chang et al. 2000). Another approach is the "A+B bidding method" used in some highway projects in the United States. In A+B bidding, a tender proposal is required to incorporate two packages: part A, the bid price in dollars for all contracted works; and part B, the contract time that is converted to a cost to the client based on opportunity costs to road users in terms of "dollar value per day." The contractor is selected based on the combined price, A+B, in dollars (Herbsman 1995).

Design-Build Contracts

The best value of the DB contract lies in its single point of responsibility, which facilitates innovations in design and construction (Design-Build Institute of America 1999). Palaneeswaran (2000) has identified ten BVCFs in DB contracts and determined their relative importance through a questionnaire survey. The ten BVCFs in order of decreasing importance are (1) improved maintainability and less operating costs, (2) earlier project completion time, (3) increased product life, (4) lower life-cycle costs, (5) additional facilities, (6) better aesthetic/architectural value, (7) enhanced benefits for the local economy, (8) more environmentally friendly, (9) fitness for multiple/flexible use, and (10) modular and repeatable design/construction. The "best design–best price" approach has been adopted by the U.S. Department of Agriculture in their Beltsville Headquarters Office Complex project, in which a $37.7 million target price is set up and potential contractors are invited to "bid up for quality" (Wright 1998).

Design-Build-Maintain and Design-Build-Operate Contracts

In DBM and DBO contracts, values are further explored by transferring maintenance and operation risks of the constructed facilities to the design-build contractor. For example, in the DBO Tolt water treatment plant in Seattle, the client aims to achieve the following values: (1) optimization of water treatment processes and integrated operations, (2) short construction period, (3) minimization of design, construction, maintenance, and operation costs, and (4) quality services to the public (Kelly et al. 1998).

Public-Private Partnership Contracts

Public clients have three main objectives in PPPs: (1) mobilization of private sector funds, technologies, managerial skills, and operational efficiency; (2) transfer to the private sector risks

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that can be best managed by them, including design and construction risks, operating risks, revenue stream risks, and risks of technological obsolescence; and (3) better value for money (i.e., enhanced services at lower costs) than can be obtained by a traditional public procurement route (Higher Education Funding Council for England 1997). To encourage innovations, PPP contracts should be performance based, that is, the client states “what needs to be achieved” rather than “how to get the job done.” The Office of Federal Procurement Policy (1998) lists key elements of performance based contracts: (1) outcomes, (2) performance specifications/standards, (3) compensation coupled with incentive/disincentives, and (4) monitoring and measurement techniques.

Best Value Contributing Factors in Public-Private Partnerships

The writer has studied worldwide PPP practices, including PFI projects in the United Kingdom, BOT-type toll roads under the Intermodal Surface Transportation Efficiency Act in the United States (Levy 1996), BOT tunnel projects in Hong Kong, and BOT power and transportation projects in China, India, Malaysia, the Philippines, and Thailand. This, supplemented by a literature review of previous studies on BVCFs in DBB, DB, DBM, and DBO contracts, enabled the writer to develop a set of 21 BVCFs in PPPs (Table 1), which was finalized by interviews and correspondence with worldwide PPP experts/experienced practitioners from different public client organizations for their opinions on the relative significance of these BVCFs.

Significance Indexes and Rankings of Best Value Contributing Factors

Questionnaire Survey

The writer conducted a structured questionnaire survey from December 2000 through May 2001 of international expert opinions on various issues related to the procurement of BOT-type PPP projects. Forty-six respondents returned complete questionnaires. They are 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, United Kingdom, and United States. Twenty-nine respondents are from industry and 17 from academia. Many of the respondents are from organizations that have rich experience in PPP projects. Zhang (2004) provides the background information of these respondents including countrywise respondent breakdown details and respondent breakdown based on their working background (academia or industry) and organization type (public, quasi government, or private).

In the questionnaire survey, respondents were requested to indicate the significance of the BVCFs 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”). Consolidated summaries of the responses appears in Tables 2–4.

Method for Calculating Best Value Contributing Factor Significance Indexes

The significance indexes of the BVCFs are calculated according to the following formula:

$$S_i = \frac{N_{i0}\times 0 + N_{i1}\times 1 + N_{i2}\times 2 + N_{i3}\times 3 + N_{i4}\times 4 + N_{i5}\times 5}{N_{i0}+N_{i1}+N_{i2}+N_{i3}+N_{i4}+N_{i5}} = \frac{N_{i1}+2N_{i2}+3N_{i3}+4N_{i4}+5N_{i5}}{N_{i0}+N_{i1}+N_{i2}+N_{i3}+N_{i4}+N_{i5}}$$

where S_i=significance index for ith BVCF; N_{i0}=number of responses 0 for ith BVCF; N_{i1}=number of responses 1 for ith BVCF; N_{i2}=number of responses 2 for ith BVCF; N_{i3}=number of responses 3 for ith BVCF; N_{i4}=number of responses 4 for ith BVCF; and N_{i5}=number of responses 5 for ith BVCF.

Removal of Outliers

It is assumed that the responses to the significance of the BVCF follow normal distributions. We know that 95% of a normally distributed data set lies within two standard deviations (2σ) of the mean (μ), that is, within ($\mu-2\sigma, \mu+2\sigma$). Responses outside that range are removed as outliers. In Tables 2–4, μ_1 is the mean of the significance indexes based on the responses before the removal of the outliers, while μ_2 is the mean after the removal of the outliers. The rankings of the significance indexes of the BVCFs are based on μ_2.

Significance Indexes and Rankings of Best Value Contributing Factors

Overall Responses

Consolidated summaries of the significance indexes and rankings of the BVCFs based on all responses appear in Table 2. It is seen that except for the two BVCFs of “modular and repeatable design/construction” (significance index 2.5) and “additional facilities/services beyond client requirements” (significance index 2.3), which are at a significance level between “fairly significant” and “significant), and “technical innovation” (significance index 2.9), which is very close to the “significant” level, all other BVCFs have a significance level greater than 3 (“significant”). This indicates that almost all of these BVCFs are important and, therefore, should be taken into account in a best value approach to PPPs.

The top ten BVCFs (which have a significance level equal to or greater than 3.5) are (1) transfer of risks related to construction, finance, and operation, (2) reducing the size of public borrowing via off-balance-sheet financing, (3) reduced disputes and claims, (4) acquisition of a fully completed and operational facility, (5) additionality (acquisition of facilities that would otherwise not be built by the public sector), (6) long project life span, (7) low tariffs/tolls, (8) optimized resource utilization, (9) low project life-cycle cost, and (10) early project completion/product or service delivery.

Academic Responses

Consolidated summaries of the significance indexes and rankings of the BVCFs based on academic responses appear in Table 3. Except for “modular and repeatable design/construction” (significance index 2.1), which is rated at a “fairly significant” level, and “technical innovation” (significance index 2.9), and “additional facilities/services beyond client requirements” (significance index 2.8), which are rated very close to a “significant level,” all other BVCFs have a significance level greater than 3 (“significant”).

Table 1. Best Value Contributing Factors for Public Private Partnerships in General

BVCFs	Remarks
Transfer of risks related to construction, finance, and operation	Public clients take a variety of risks in traditional procurements of works and services. Transfer to the private sector of risks that are better managed by them will increase project development efficiency.
Reducing the size of public borrowing via off- balance-sheet financing	In off-balance-sheet transaction, lenders look primarily to the project's revenues for repayment and to its assets as collateral for their loan. They have no recourse or only limited recourse to the general funds or assets of project sponsors.
Benefits to local economy	This refers to the offers in alternative tender proposals that benefit local economic development.
Early project completion/ product or service delivery	There is a substantial time value to the customers related to the early availability of products/services.
Acquisition of a fully completed and operational facility	Pubic client may not have various resources required for the development of a project even if they have an urgent need of it. Resources from the private sector can lead to a fully completed and operational facility.
Low project life-cycle cost	The integration of finance, design, construction and operation in a single source, the concessionaire, facilitates the achievement of a low life-cycle cost of the project.
Reduced public administrative costs	Great costs are incurred in the administration of public works procured in a traditional way, especially in dealing with those risks that may be better controlled by the private sector.
Reduced disputes and claims	PPPs reverse the overfragmentation of functions in a traditional design-bid-build contract that often leads to divergent if not confrontational agendas of the multiple participants, providing a great potential of reduced disputes and claims.
Low tariffs/tolls	The level of tariffs/ tolls measures the cost to use the facilities of the project. It also determines the profit level of the concessionaire. Improved efficiency makes possible low level of tariffs/ tolls.
Long project life span	Longer life span means longer period availability of products or services. For a PPP project with a specific concession period, longer span means longer remaining service period after transfer of the project to the client.
Optimized resources utilization	This increases project development efficiency, reduces costs and makes possible better offers to the public.
Additionality (acquisition of facilities that would otherwise not be built by the public sector)	This refers to projects developed as a result of unsolicited project proposals. When there is an initiative for PPPs in a public organization, private developers may go to this organization for possible PPP projects with their proposals.
Utilization of private managerial skills and technologies	Utilization of skills and technologies that are not available from the public sector enhances project development process, increases efficiency and reduces costs.
Environment friendly	Environmental issues become increasingly important, and are one of the key assessment areas in tender evaluation.
Transfer of technologies	This facilitates the operation and management of the current project beyond the concession period, and the development of new projects.
Increased project development and operation efficiencies	This makes possible low life-cycle project costs.
Improved constructability and maintainability	Constructability and maintainability are two important issues to be considered in design. Single source point in PPP projects encourages adequate attention paid to these two issues.
Additional financial sources for priority projects	This refers to the public money to be shifted from the PPP project to other important projects.
Technical innovation	A single source point encourages technical innovation and consequent improved project development.
Additional facilities/services beyond client requirements	The concessionaire may provide additional facilities beyond public client's requirements in a competitive tendering process.
Modular and repeatable design/ construction	This facilitates the public client to develop similar projects in the future.

The top ten BVCFs ranked by overall responses are also rated at a significance level greater than 3.5 and nine of them also ranked among the top ten by academic responses. "Benefits to local economy" and "reduced public administrative costs" are the other two top-ten BVCFs in academic responses. Here, it should be noted that among the top 11 BVCFs in the academic ranking, the last three are tied in their ranks.

Industrial Responses

Consolidated summaries of the significance indexes and rankings of the BVCFs based on industrial responses appear in Table 4. Except for "technical innovation" (significance index 2.72), "transfer of technologies" (significance index 2.7), and "modular and repeatable design/construction" (significance index 2.7), which are rated at a level close to "significant," and "additional

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Table 2. Significances and Ranks of Best Value Contributing Factors (BVCFs) in Public Private Partnerships Based on All Responses

BVCFs	Number of responses						Mean significance index μ_1	Standard deviation σ	$\mu_1-2\sigma$	$\mu_1+2\sigma$	Mean significance index μ_2	Rank
	0	1	2	3	4	5						
Transfer of risks related to construction, finance, and operation	0	0	1	6	23	15	4.2	0.74	2.7	5.6	4.2	1
Reducing the size of public borrowing via off-balance-sheet financing	2	0	4	13	11	15	3.7	1.28	1.1	6.2	3.9	2
Reduced disputes and claims	1	3	5	11	20	6	3.4	1.18	1.0	5.8	3.6	3
Acquisition of a fully completed and operational facility	0	2	3	19	14	8	3.5	1.01	1.5	5.5	3.6	3
Additionality (acquisition of facilities that would otherwise not be built by the public sector)	1	3	4	10	15	9	3.5	1.27	0.9	6.0	3.6	3
Long project life span	0	2	6	13	18	6	3.4	1.03	1.4	5.5	3.6	3
Low tariffs/tolls	0	2	9	11	13	10	3.4	1.18	1.1	5.8	3.6	3
Optimized resources utilization	0	3	7	10	17	6	3.4	1.13	1.1	5.6	3.6	3
Low project life-cycle cost	0	1	10	9	15	9	3.5	1.13	1.2	5.7	3.5	4
Early project completion/product or service delivery	0	0	9	13	14	9	3.5	1.04	1.4	5.6	3.5	4
Benefits to local economy	0	0	6	18	16	5	3.4	0.87	1.7	5.2	3.4	5
Increased project development and operation efficiencies	0	0	7	14	18	4	3.4	0.88	1.7	5.2	3.4	5
Improved constructability and maintainability	1	2	5	16	17	3	3.3	1.06	1.1	5.4	3.4	5
Additional financial sources for priority projects	0	0	13	8	14	7	3.4	1.10	1.2	5.6	3.4	5
Reduced public administrative costs	1	3	7	13	11	8	3.3	1.27	0.7	5.8	3.3	6
Utilization of private managerial skills and technologies	1	1	8	18	11	5	3.2	1.08	1.0	5.4	3.3	6
Environment friendly	0	0	13	14	11	5	3.2	1.01	1.2	5.2	3.2	7
Transfer of technologies	0	3	10	16	9	3	3	1.04	0.9	5.1	3.0	8
Technical innovation	0	7	7	20	10	2	3	1.07	0.7	5.0	2.9	9
Modular and repeatable design/construction	2	7	12	16	6	1	2.5	1.13	0.2	4.7	2.5	10
Additional facilities/ services beyond client requirements	1	9	13	17	2	2	2.4	1.08	0.2	4.5	2.3	11

Table 3. Significances and Ranks of Best Value Contributing Factors (BVCFs) in Public Private Partnerships Based on Academic Responses

BVCFs	Number of responses						Mean significance index μ_1	Standard deviation σ	$\mu_1-2\sigma$	$\mu_1+2\sigma$	Mean significance index μ_2	Rank
	0	1	2	3	4	5						
Transfer of risks related to construction, finance, and operation	0	0	1	1	9	5	4.1	0.81	2.5	5.7	4.3	1
Reducing the size of public borrowing via off-balance-sheet financing	0	0	1	4	5	6	4.0	0.97	2.1	5.9	4.1	2
Benefits to local economy	0	0	0	5	7	4	3.9	0.77	2.4	5.5	3.9	3
Early project completion/ product or service delivery	0	0	1	5	5	5	3.9	0.96	2.0	5.8	3.9	3
Acquisition of a fully completed and operational facility	0	0	0	8	3	5	3.8	0.91	2.0	5.6	3.8	4
Low project life cycle cost	0	0	3	1	9	3	3.8	1.00	1.8	5.8	3.8	4
Reduced public administrative costs	0	0	0	6	6	2	3.7	0.73	2.3	5.2	3.7	5
Reduced disputes and claims	0	1	1	4	9	1	3.5	0.97	1.6	5.4	3.7	5
Low tariffs/tolls	0	0	3	3	7	3	3.6	1.02	1.6	5.7	3.6	6
Long project life span	0	1	2	4	7	2	3.4	1.09	1.3	5.6	3.6	6
Optimized resources utilization	0	1	2	3	8	1	3.4	1.06	1.3	5.5	3.6	6
Additionality (acquisition of facilities that would otherwise not be built by the public sector)	0	2	1	4	5	4	3.5	1.32	0.9	6.1	3.5	7
Utilization of private managerial skills and technologies	1	1	1	5	5	2	3.2	1.37	0.5	6.0	3.4	8
Environment friendly	0	0	2	6	5	1	3.4	0.84	1.7	5.0	3.4	8
Transfer of technologies	0	1	3	3	6	2	3.3	1.18	1.0	5.7	3.3	9
Increased project development and operation efficiencies	0	0	2	7	7	0	3.3	0.70	1.9	4.7	3.3	9
Improved constructability and maintainability	1	1	0	9	4	1	3.1	1.18	0.7	5.4	3.3	9
Additional financial sources for priority projects	0	0	6	4	4	2	3.1	1.09	1.0	5.3	3.1	10
Technical innovation	0	3	1	7	4	1	2.9	1.18	0.6	5.3	2.9	11
Additional facilities/services beyond client requirements	0	1	3	12	0	0	2.7	0.60	1.5	3.9	2.8	12
Modular and repeatable design/ construction	1	3	5	6	0	1	2.3	1.18	−0.1	4.6	2.1	13

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Table 4. Significances and Ranks of Best Value Contributing Factors (BVCFs) in Public Private Partnerships Based on Industrial Responses

BVCFs	Number of responses 0	1	2	3	4	5	Mean significance index μ_1	Standard deviation σ	$\mu_1-2\sigma$	$\mu_1+2\sigma$	Mean significance index μ_2	Rank
Transfer of risks related to construction, finance, and operation	0	0	0	5	14	10	4.2	0.71	2.8	5.6	4.2	1
Reducing the size of public borrowing via off-balance-sheet financing	2	0	3	9	6	9	3.5	1.40	0.7	6.3	3.8	2
Additionality (acquisition of facilities that would otherwise not be built by the public sector)	1	1	3	6	10	5	3.5	1.27	0.9	6.0	3.6	3
Long project life span	0	1	4	9	11	4	3.5	1.02	1.4	5.5	3.5	4
Increased project development and operation efficiencies	0	0	5	7	11	4	3.5	0.98	1.6	5.5	3.5	4
Additional financial sources for priority projects	0	0	7	4	10	5	3.5	1.10	1.3	5.7	3.5	4
Acquisition of a fully completed and operational facility	0	2	3	11	11	3	3.3	1.03	1.3	5.4	3.5	4
Reduced disputes and claims	1	2	4	7	11	5	3.3	1.30	0.7	5.9	3.5	4
Improved constructability and maintainability	0	1	5	7	13	2	3.4	0.99	1.4	5.3	3.4	5
Optimized resources utilization	0	2	5	7	9	5	3.4	1.19	1.0	5.7	3.4	5
Low tariffs/ tolls	0	2	6	8	6	7	3.3	1.26	0.8	5.9	3.3	6
Low project life-cycle cost	0	1	7	8	6	6	3.3	1.19	1.0	5.7	3.3	6
Early project completion/ product or service delivery	0	0	8	8	9	4	3.3	1.04	1.2	5.4	3.3	6
Utilization of private managerial skills and technologies	0	0	7	13	6	3	3.2	0.93	1.3	5.0	3.2	7
Reduced public administrative costs	1	3	7	7	5	6	3.0	1.43	0.2	5.9	3.1	8
Benefits to local economy	0	0	6	13	9	1	3.2	0.80	1.6	4.8	3.1	8
Environment friendly	0	0	11	8	6	4	3.1	1.08	0.9	5.3	3.1	8
Technical innovation	0	4	6	13	6	1	2.8	1.03	0.7	4.9	2.7	9
Transfer of technologies	0	2	7	13	3	1	2.8	0.91	1.0	4.6	2.7	9
Modular and repeatable design/ construction	1	4	7	10	6	0	2.6	1.10	0.4	4.8	2.7	9
Additional facilities/ services beyond client requirements	1	8	10	5	2	2	2.2	1.25	−0.3	4.7	2.0	10

facilities/services beyond client requirements" (significance index 2.0), which is rated at a "fairly significant level," all other BVCFs have a significance level greater than 3 ("significant").

Seven of the top ten BVCFs ranked by overall responses are also ranked among the top ten in industrial responses. "Increased project development and operation efficiencies," "additional financial sources for priority projects," and "improved constructability and maintainability" are the other three top-ten BVCFs in industrial responses. The top ten BVCFs by overall responses are rated at a significance level greater than 3.3 in industrial responses.

Rank Agreement Analysis

From the above descriptive analysis of the significance indexes and the rankings of the BVCFs, it is seen that there is no significant difference in the ratings of the BVCFs between the academic and the industrial sectors. Okpala and Aniekwu (1988) provide a quantitative method for rank agreement analysis between two groups, where the rank agreement factor (RA) is used. The RA shows the average absolute difference in the ranking of the items between two groups. For any two groups, let the rank of the ith item in group 1 be R_{i1} and in group 2 be R_{i2}. Let N be the total number of items to be ranked and $j=N-i+1$. Then the RA is defined as

$$RA=\frac{\sum_{i=1}^{N}|R_{i1}-R_{i2}|}{N}$$

The maximum rank agreement factor ($RA_{\max}$) is defined as

$$RA_{\max}=\frac{\sum_{i=1}^{N}|R_{i1}-R_{j2}|}{N}$$

The percentage disagreement (PD) is defined as

$$PD=\frac{\sum_{i=1}^{N}|R_{i1}-R_{i2}|}{\sum_{i=1}^{N}|R_{i1}-R_{j2}|}\times 100$$

The percentage agreement (PA) is defined as

$$PA=100-PD$$

The higher the value of RA is, the lower the agreement between the two groups. A RA of zero means perfect agreement. As shown in Table 5, in the rankings of the BVCFs between the academic and industrial groups, $RA=2.14$, $RA_{\max}=10.48$, and $PA=79.55\%$. This also shows that there is a high agreement in the ranking of the BVCFs between the two groups.

Application of Best Value Contributing Factors in a Best Value Source Selection Process

Two Possible Methods for Using Best Value Contributing Factors

Both objective and subjective criteria need to be established to measure each BVCF in a BVSS process. There are two possible

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Table 5. Rank Agreement Analysis

Number	Best value contributing factors	Actual difference in rank			Maximum absolute difference in rank		
		Ranking by academic group	Ranking by industrial group	Absolute difference in rank	Ranking by academic group	Ranking by industrial group	Maximum absolute difference in rank
1	Transfer of risks related to construction, finance and operation	1	1	0	1	21	20
2	Reducing the size of public borrowing via off balance sheet financing	2	2	0	2	20	18
3	Benefits to local economy	3	8	5	3	19	16
4	Early project completion/ product or service delivery	3	6	3	4	18	14
5	Acquisition of a fully completed and operational facility	4	4	0	5	17	12
6	Low project life cycle cost	4	6	2	6	16	10
7	Reduced public administrative costs	5	8	3	7	15	8
8	Reduced disputes and claims	5	4	1	8	14	6
9	Low tariffs/ tolls	6	6	0	9	13	4
10	Long project life span	6	4	2	10	12	2
11	Optimized resources utilization	6	5	1	11	11	0
12	Additionality (acquisition of facilities that would otherwise not be built by the public sector)	7	3	4	12	10	2
13	Utilization of private managerial skills and technologies	8	7	1	13	9	4
14	Environment friendly	8	8	0	14	8	6
15	Transfer of technologies	9	9	0	15	7	8
16	Increased project development and operation efficiencies	9	4	5	16	6	10
17	Improved constructability and maintainability	9	5	4	17	5	12
18	Additional financial sources for priority projects	10	4	6	18	4	14
19	Technical innovation	11	9	2	19	3	16
20	Additional facilities/ services beyond client requirements	12	10	2	20	2	18
21	Modular and repeatable design/ construction	13	9	4	21	1	20

Note: Rank agreement factor (RA)=2.14, maximum rank agreement factor (RA_{max})=10.48, and percentage agreement (PA)=79.55%.

methods to do this. One method is to treat each BVCF as an assessment area, and evaluate it against a general set of predetermined criteria. For example, in the PFI projects in the United Kingdom, each assessment area is examined against a set of criteria including innovation, compatibility with operational approach, deliverability, flexibility, and risk transfer (Blackwell 2000).

The other method is to further classify each BVCF into two categories of criteria: "must" and "want" (Kepner and Tregoe 1981). Taking "transfer of risks related to construction, finance, and operation" as an example, the "must" criteria may include (1) the construction must be completed before a certain date, (2) there is no host-government financial guarantee, and (3) the equity/debt ratio must be higher than a certain level; and the "want" criteria may include (1) construction and operation methods, (2) total investment schedule, and (3) sources and structure of standby financing facilities.

Multicriteria Tender Evaluation

The BVSS process requires a suitable multicriterion evaluation methodology to examine alternative proposals. Zhang (2004) has discussed several tender evaluation methods and their applications, including

1. Simple scoring method,
2. Multiattribute analysis,
3. Kepner-Tregoe decision analysis technique,
4. Two-envelope method,
5. Net present value (NPV) method+scoring method, and
6. Binary method+NPV method.

For example, a simple scoring method has been used in PPP transportation projects in California, multiattribute analysis has been used in PFI projects in the United Kingdom, and Kepner-Tregoe decision analysis technique has been used in BOT tunnel projects in Hong Kong.

In a BVSS approach, tender evaluation should be impartial, equitable, and thorough, such that a sound and defensible contract award decision can be made and the best source is selected. In addition, the BVSS process should be efficient, effective, and economic such that the tendering costs of the industry and evaluation expenses of the client are minimized.

Conclusions

Best value should be the ultimate goal of various types of public private partnered infrastructure projects. This necessitates a BVSS process, which must be well structured and sufficiently flexible to accommodate the general business requirements of the client, and the specific objectives, attributes, and conditions of the particular PPP project. The general requirements and specific objectives should be further defined in terms of BVCFs, against which alternative proposals are evaluated.

Twenty-one BVCFs for PPPs in general have been identified in a systematic research approach. Descriptive comparison and

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rank agreement analysis show that there is no statistical difference in the ranking of these BVCFs between the academic and the industrial groups. Except for four BVCFs that are at a significance level between "fairly significant" and "significant," all other BVCFs are at a significance level greater than "significant," no matter by overall ranking, academic ranking, or industrial ranking. Therefore, it can be concluded that almost all of these BVCFs are important and should be considered in a best value approach in PPPs in infrastructure development. However, in tailoring these BVCFs to a specific PPP project, adjustments should be made to reflect the public client's general business needs and the uniqueness of the particular project.

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