Company and Project Evaluation Model for Privately Promoted Infrastructure Projects

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Abstract: The decline in government funds and the increased demand on public agencies for the construction of new (or the rehabilitation of existing) infrastructure projects has led to the growth of alternative forms of project development, such as BOT and BOO. The Desirability Model, presented in this paper, is a multiattribute evaluation model that provides a logical, reliable, and consistent procedure for assessing the capability of a private-sector company to become a promoter for a given project and the attractiveness of an infrastructure project to be actively promoted by a given company. The proposed model was developed with the assistance of 14 experts from around the world. It produces two indices (one for company competencies and one for project attractiveness) that depend on the actual performance levels of a total of 23 company and project attributes. The model has been validated by comparing these indices to the experts' holistic evaluations of 19 company and project profiles. Example applications of the model include the evaluation of the Eurotunnel and an illustration of how sensitivity analysis can identify strategies for project improvement.

INTRODUCTION

The shortage of public funds to finance the construction of new infrastructure projects and the rehabilitation of existing facilities, coupled with increased demands for capital on traditional alternative sources (e.g., national and international development banks and agencies), has contributed to the creation or resurgence of alternative forms of project development. Well-publicized examples are BOT (build-operate-transfer) and BOO (build-operate-own) projects where private-sector companies (including construction companies) become responsible for project promotion (including feasibility studies, project finance, design, construction, and operation).

The need for alternative forms of infrastructure project development promises to intensify as population grows, environmental regulation increases, and infrastructure ages creating high demands for capital spending. In the United States, for example, the availability of federal grants for public works projects has been constrained by budget deficits, while the ability of state and municipal governments to finance construction through bond issues has been affected by changes in tax laws and limits on debt capacity imposed by law, political considerations, and capital markets (Beidleman et al. 1991). The Private Sector Advisory Panel on Infrastructure Financing to the Senate Budget Committee estimated that the shortage of infrastructure funds between 1988 and the year 2000 would be $240–488 billion nationwide with many localities already experiencing budget deficits (Lammie 1988). Other estimates range from $30 billion to simply recuperate the bridges and roads in the worst condition, to $500 billion to rebuild highways and airports and to help create digital data networks. According to the International Finance Corporation (IFC), developing countries will require more than $3 trillion in new infrastructure over the next 10 yr.

In addition to the lack of funding resources, there is an increased understanding on the part of governments that they should not own and/or operate certain types of facilities because of their less effective utilization of resources, when compared with the more flexible and cost-conscious private sector, and because of political changes toward democratization and decentralization. Private enterprises can benefit from this situation by providing financial resources and managerial skills to increase their work volume, to secure long-term revenues, to diversify, to create new alliances, and to increase their market share by becoming active promoters of infrastructure projects.

This paper focuses on the fundamental questions of whether a potential infrastructure project has the necessary characteristics for successful promotion by a private-sector company, and whether a company has the capability to undertake the promotion of such a project. The Desirability Model (DM) is a multiattribute model that addresses both these issues from the promoter's point of view. It provides a logical, reliable, and consistent procedure for the evaluation of potential projects and companies, and facilitates a company's decision to engage in the private promotion of an infrastructure project.

THE DESIRABILITY MODEL

The DM is a multiattribute evaluation model composed of two modules: company competencies (CC) and project attractiveness (PA). The company module evaluates the capability of a private-sector company to provide and allocate the resources necessary to promote a given infrastructure project. The project module evaluates the attractiveness of a project as a candidate for private promotion by a given company.

The model was developed with the cooperation of 14 experts from around the world (Appendix I). Information was gathered through a series of four "dynamically designed" questionnaires that provided custom feedback about the previous responses of each expert in relationship to the entire group (Dias 1994; Dias and Ioannou 1995). The participating experts were divided into two groups: eight insiders and six outsiders. The insiders were those experts whose affiliation suggested they would look at a project from the promoter's point of view (i.e., their companies could be viewed as an active member of the promoting team). The outsiders were those experts who most likely would advise companies as to their participation. The main reason for separating the experts into two groups was to investigate whether experts within each group had similar perspectives and whether the different role of each group in the promotion process would reflect differences in opinion.

The DM has a three-level hierarchical structure. The highest level of the model consists of two classes: company competencies and project attractiveness (these correspond to the two modules). The second level consists of seven categories and

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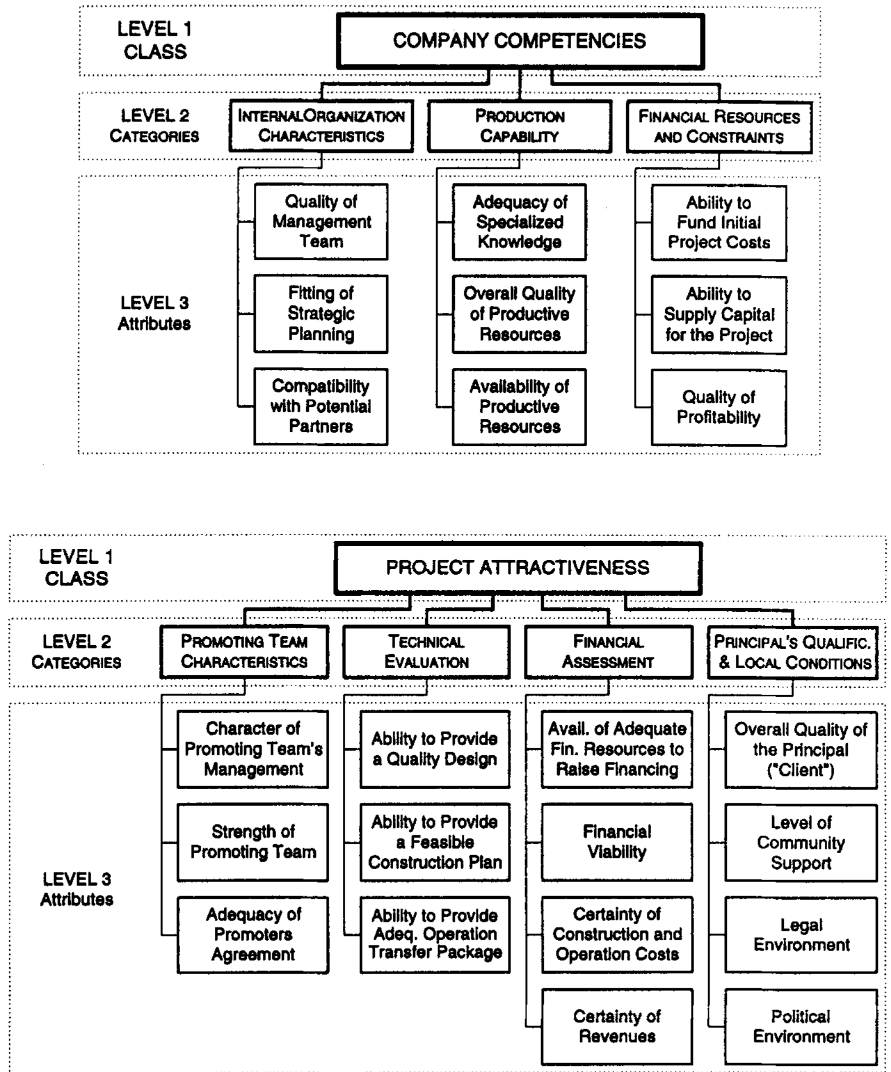

FIG. 1. Hierarchical Structure of Desirability Model

the third level consists of 23 attributes. Fig. 1 illustrates the complete model structure. Appendix II provides the definitions for all attributes grouped by category.

Typical hierarchical multicriteria decision models have more than one alternative to choose from, and the objective of the decision maker is to find the alternative that best fits the overall focus or goal of the situation being analyzed. In contrast, the objective of the DM is to evaluate whether a particular project should be privately promoted and whether the potential promoting company has the capability to do so. Therefore, the level "alternatives," typically found at the top of the model hierarchy, does not apply to the DM. The null alternative is simply not to proceed with the private promotion of the project by the company.

The final outcome of the DM are two indices that assess the capability of the company, $v(\bar{x})_{CC}$, and the feasibility of the project, $v(\bar{x})_{PA}$. These indices are given by additive multiattribute value functions that have the following general form:

$$v(\bar{x})_{CC\ (or\ PA)} = \delta \sum_{i=1}^{n} w_i v_i(x_i) \tag{1}$$

This functional form was chosen on the basis of the recommendations for multiattribute aggregation procedures in Dawes and Corrigan (1974), Gardiner (1974), Einhorn and Hogarth (1975), Keeney and Raiffa (1976), Dawes (1979), Dyer and Sarin (1979), and von Winterfeldt and Edwards (1986).

As shown in Fig. 1, the CC index $v(\bar{x})_{CC}$ uses n = nine attributes x_i, whereas the PA index $v(\bar{x})_{PA}$ uses $n = 14$ attributes. In both cases, the overall contribution of each attribute is given by its worth score $v_i(x_i)$ multiplied by its composite weight w_i.

The worth score of an attribute $v_i(x_i)$ reflects the one-dimensional value of the performance level of the attribute as it exists for a specific project or company. The composite weight of an attribute w_i, reflects its importance relative to the other attributes (for the same index) irrespective of any particular project or company. The factor δ equals either 1 or 0 depending on whether the dominant attributes for a project or company exceed certain minimum acceptable performance thresholds.

ONE-DIMENSIONAL VALUE FUNCTIONS

To determine the one-dimensional attribute worth score $v_i(x_i)$ it is necessary to evaluate the performance (quality) level x_i of the ith attribute for a given project or company and then to use a value function $v_i(\ )$ to transform it into an equivalent worth score.

The transformation from the performance (quality) level x_i of the ith attribute into an equivalent worth score $v_i(x_i)$ requires two steps. Since the 23 attributes in the DM hierarchy are

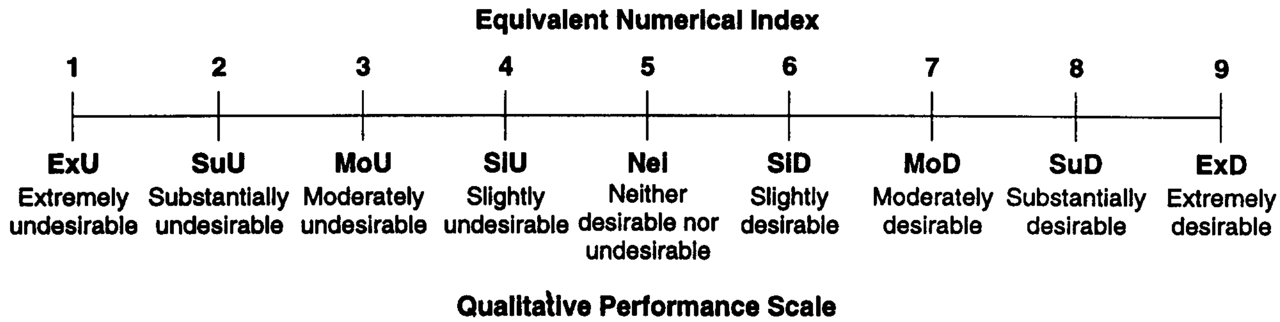

FIG. 2. Qualitative Attribute Performance Scale

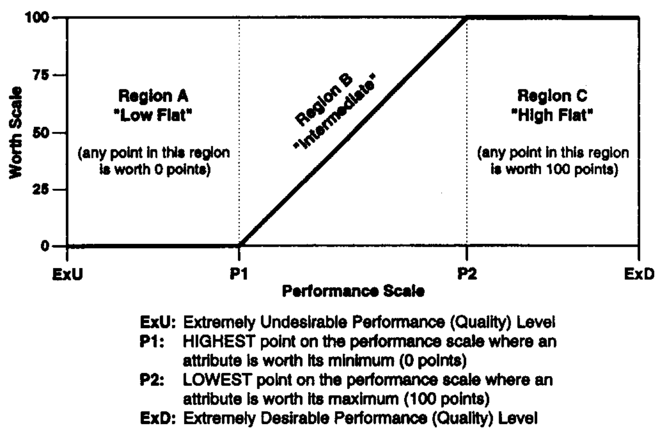

FIG. 3. Generic Form of Value Curves for Model Attributes

qualitative in nature (Fig. 1), the first step is to assess how well a given project or company performs with respect to a given attribute i using a meaningful qualitative scale. This is essentially an "attribute measurement" step whose outcome is project- and company-specific. The second step is to transform this qualitative performance value into a one-dimensional worth (or value) score (from 0 to 100). This is a "preference measurement" procedure whose outcome depends on the preferences and judgment of the person doing the analysis.

This two-step procedure allows the disassociation between the task of measuring the location of an attribute on the performance scale from the task of determining the worth of the attribute on the worth scale. That is, it separates qualitative judgments that are specific to a project or company from the quantitative transformation to value (worth) that can be reused from one project or company to another.

The qualitative attribute measurement scale used to quantify the qualitative assessment for any attribute i is shown in Fig. 2. This scale incorporates nine performance levels and has been adapted from Saaty (1980). Each qualitative descriptor at the bottom of the scale has been matched to a numerical index value x_i (1–9) to allow a simple shorthand way to refer to any particular attribute level using a single number. This is particularly convenient when presenting attribute performance levels in table format.

The one-dimensional value (worth) functions for all attributes have the same generic form shown in Fig. 3. This functional form consists of three linear regions defined by two points, P1 and P2, that are different for each attribute. It has been adopted from a similar study (Ioannou 1992) that used a multiattribute evaluation system with more than 50 attributes to rank more than 1,000 research proposals that competed for funding out of a program budget of $34,000,000.

P1, the minimum acceptable attribute performance level, reflects the highest point on the performance scale where an attribute has minimum value (i.e., 0 worth points). P2, reflects the lowest point on the performance scale where an attribute is worth its maximum (i.e., 100 worth points).

These two points divide the performance scale into three regions: a low flat region (A), an intermediate region (B), and a high flat region (C). Region A ("low flat") indicates unacceptable performance. Thus, the attribute being evaluated does not need to be a "complete disaster" in order to be worth zero points. Region C ("high flat") indicates that the attribute's performance is high enough to have maximum worth. Thus, an attribute does not need to be "perfect" in order to be worth 100 points. Region B ("intermediate") represents the "gray" area between unacceptable and completely acceptable performance.

The entire set of P1 and P2 values for all 23 attributes organized by group (insiders versus outsiders) and by individual expert are shown in Tables A.1 and A.2 in Appendix III. Given an attribute performance level x_i (assessed for a specific project or company), the pairs P1 and P2 in these tables can be used to determine the worth (value) of this attribute $v_i(x_i)$ for any of the 14 experts. It is interesting to note that for about 80% of the attributes P1(insiders) < P1(outsiders) and for about 60% of the cases P2(outsiders) < P2(insiders). As a result, outsiders have, on average, steeper value curves than the insiders do. Also, region B (the "gray area") is larger for the insiders than for the outsiders.

DECOMPOSED ASSESSMENT OF ATTRIBUTE WEIGHTS

To arrive at an overall desirability index, the worth (value) of each attribute $v_i(x_i)$ must be multiplied by its "global" weight w_i [(1)]. Two different decomposition methods were used to determine these weights: the direct rating method (DRM) and the eigenvalue method (EM). This allowed us to investigate whether the two methods yield different weights, and in case of weight differences, to assess whether these lead to differences in model prediction.

The DRM was developed by Edwards (1971, 1977) as part of the simple multi-attribute rating technique (SMART). The EM was developed by Saaty (1980) as part of the Analytic Hierarchy Process (AHP). Due to space limitations, a detailed description of these encoding methods cannot be presented here. A review of some of the multiattribute models developed using SMART appears in von Winterfeldt and Edwards (1986). A comprehensive review of AHP applications appears in Zahedi (1986), Vachnadze and Markozashvili (1987), and Vargas (1990).

In principle, the direct determination of the "global" weights in (1) would require a large number of pairwise attribute comparisons in order to assess their relative importance. For example, the 14 attributes for the PA index would require 91 such pairwise comparisons. To minimize the assessment effort, both decomposition methods take advantage of the hierarchical structure of the model and encode separate "local" weights, first for each category, and then for each attribute within each category. Thus, for example, the number of comparisons required for the PA index is reduced to 24 (six for categories and 18 for attributes). The required 14 "global" attribute weights are then determined as "composite" weights by multiplying the 14 "local" attribute weights by the corresponding category weight. Besides the reduction in assessment effort, this approach has the additional advantage of providing weights for every level in the model hierarchy (in this case for categories).

Category Weights

The three category weights for the CC index and the four category weights for the PA index were obtained by performing pairwise comparisons among the model categories using both the DRM and EM. The individual weights assessed for each expert can be found in Dias (1994), and Dias and Ioannou (1995). Table 1 shows the group weights for insiders and outsiders as determined by each encoding method. These form the basis for comparing the two groups.

For the DRM, group category weights were given by the average of the individual category weights. For the EM, the assessment of group weights was performed indirectly. The pairwise comparison matrices (one for each individual expert) were first consolidated into one group matrix by computing the geometric mean of the individual "category comparisons" (matrix elements) as suggested in Aczel and Saaty (1983) and McCarthy (1992). The resulting group matrix was then used to determine the group weights following the standard EM procedure as for any individual expert.

The weights for the CC index in Table 1 indicate that both insiders and outsiders consider the financial category as the most important, with the management and production categories coming in second and third. Thus, a company's ability to fund the procurement process and to provide equity to finance at least part of the project, coupled with the quality of the investment in terms of potential return, is of vital importance in the decision to get involved in the private promotion of infrastructure projects. The relatively low importance attached to the production category indicates that companies are not constrained by the availability of their own resources and technical expertise as they can rely on third parties to supply the necessary resources and expertise to have the project developed and implemented.

Similarly, in the case of the PA index, both insiders and outsiders rank the financial category as the most important. Thus, it is essential for a project to have a favorable financial assessment to attract private promoters. The second most important category is the ability of governments to provide the necessary conditions for the project to materialize and to be operated.

It is interesting to notice that the insiders' weights for the managerial and technical categories are very close. Similarly, outsiders ranked the managerial category ahead of the technical category using the EM, whereas the ranking was reversed when using the DRM. Nevertheless, there is a notable difference in the weights of these categories, as well as in the weight of the financial category, when one group is compared to the other. Insiders input money in the process and are liable to lose their investment if the project fails. They appear to be confident about their ability to manage and to provide technical solutions to the project, and hence place high importance on the project's ability to provide an adequate return on their investment and a relative low importance to the categories that they have more control over. In contrast, outsiders provide services, mainly management and legal expertise to principals and promoters. Thus, they attribute less weight to the financial assessment (although it is still the most important), and they

TABLE 1. Group Category Weights

Attribute (1)	Insiders EM (2)	Insiders DRM (3)	Outsiders EM (4)	Outsiders DRM (5)
(a) Company competencies				
Internal organization characteristics	0.251	0.304	0.245	0.292
Production capability	0.171	0.194	0.229	0.289
Financial resources and constraints	0.578	0.502	0.529	0.419
(b) Project attractiveness				
Promoting team characteristics	0.121	0.178	0.220	0.208
Technical evaluation	0.125	0.182	0.188	0.241
Financial assessment	0.532	0.386	0.352	0.300
Principal's qualifications and local conditions	0.222	0.254	0.240	0.251

emphasize more the management and technical categories, perhaps indicating their concern that promoting companies have in the past performed poorly when implementing privately promoted projects. Past projects, for example, have suffered from mismanagement (e.g., lack of owning company identity, poor interaction between promoters), project cost overruns, and schedule delays.

Two-tailed Student and paired t-tests were ran to verify if the differences in group weights given by the insiders and outsiders were statistically significant. Four t-tests were performed for each model category. Two Student t-tests compared the category weights given by the insiders against the outsiders (one test considered the DRM and another the EM). Two paired t-tests were used to compare the weights given by the DRM against the EM (one for the insiders and the other for the outsiders). None of these tests rejected the hypotheses that the responses of insiders and outsiders were given by similar populations. Similarly, none of the paired t-tests rejected the hypotheses that the two encoding methods provided comparable weights for the same category.

Attribute Weights

The "local" attribute weights were obtained by performing pairwise comparisons between the model attributes within each category. The "global" attribute weights were then determined as "composites" by multiplying each local attribute weight by the corresponding category weight. An attribute's composite weight represents its relative importance in determining the index it belongs to [CC or PA, (1)].

The individual composite weights assessed for each expert can be found in Dias (1994) and Dias and Ioannou (1995). Table 2 is a summary of these results and shows the composite group weights for insiders and outsiders as determined by each encoding method. These were obtained through the same procedure that was used to calculate composite weights for each expert; that is, by multiplying the group local attribute weights by the group category weights. The group weights shown in Table 2 are perhaps the most important numerical results in this paper.

Fig. 4 displays the DRM weights for the 14 attributes in the PA index. In this figure, every attribute is associated with two columns; the left column is for the insiders and the right column is for the outsiders. For each attribute, the bottom (top) of the two columns indicates the minimum (maximum) weight assigned by each group of experts. The line in the middle of the darker region reflects the attribute's group weight. The darker region gives an indication of variability within each group of experts and represents one standard deviation of the individual attribute weights (one-half of the standard deviation is placed above the group weight and the other half is placed below it). Similar figures for the EM weights as well as the

TABLE 2. Group Composite Attribute Weights (× 10 E-2)

Attribute (1)	Insiders EM (2)	Insiders DRM (3)	Insiders δ (4)	Outsiders EM (5)	Outsiders DRM (6)	Outsiders δ (7)
(*a*) Internal organization characteristics						
1.1 Quality of management team	15.44	13.81	*	10.66	12.29	*
1.2 Fitting of strategic planning	5.03	8.35	—	3.93	5.33	—
1.3 Compatibility with potential partners	4.67	8.25	*	9.90	11.56	*
(*b*) Production capability						
2.1 Adequacy of specialize knowledge	10.98	9.22	*	11.14	12.04	*
2.2 Overall quality of productive resources	3.95	5.65	—	6.75	10.11	*
2.3 Availability of productive resources	2.18	4.51	—	5.00	6.75	*
(*c*) Financial resources and constraints						
3.1 Ability to fund initial project costs	20.39	18.82	*	13.18	11.70	*
3.2 Ability to supply capital for project	7.50	10.01	*	11.36	12.05	*
3.3 Quality of profitability	29.88	21.37	*	28.07	18.18	*
(*d*) Promoting team characteristics						
4.1 Character of promoting team's management	3.08	5.39	*	6.86	7.42	*
4.2 Strength of promoting team	6.32	7.53	*	7.92	7.01	*
4.3 Adequacy of promoters agreement	2.69	4.90	*	7.23	6.40	*
(*e*) Technical evaluation						
5.1 Ability to provide quality design	4.76	6.61	*	7.66	10.11	*
5.2 Ability to provide feasible construction plan	5.31	6.83	*	7.41	9.44	*
5.3 Ability to provide adequate operation-transfer package	2.44	4.76	—	3.73	4.60	*
(*f*) Financial assessment						
6.1 Availability of adequate financial sources to raise financing	6.23	7.42	*	3.00	4.01	*
6.2 Financial viability	20.66	12.69	*	13.96	9.85	*
6.3 Certainty of construction and operational costs	8.68	6.92	*	9.34	7.74	*
6.4 Certainty of revenues	17.63	11.55	*	8.93	8.36	*
(*g*) Principal's qualifications and local conditions						
7.1 Overall quality of principal	6.16	6.99	*	5.18	6.05	*
7.2 Level of community support	4.79	6.41	—	2.51	4.34	*
7.3 Legal environment	3.81	4.89	*	5.06	6.78	*
7.4 Political environment	7.44	7.12	*	11.21	7.89	*

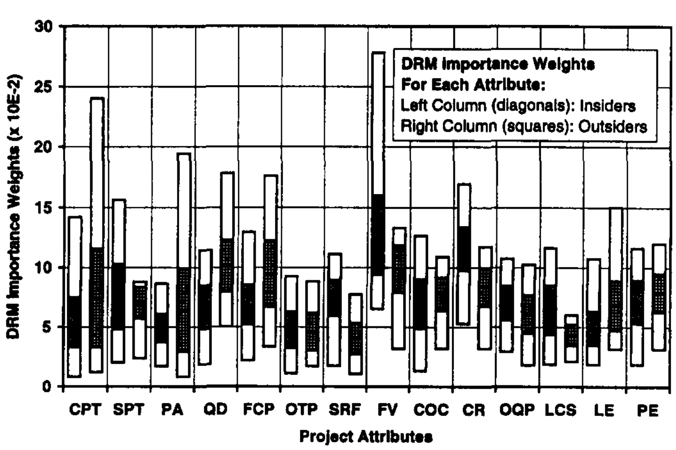

FIG. 4. DRM Group Weights and Range of Individual Weights for Attributes Belonging to PA Index

DRM and EM weights for the CC index can be found in Dias (1994) and Dias and Ioannou (1995).

THE DELTA FACTOR

The delta factor, δ in (1), was introduced in the DM to account for situations where a single dominant attribute's performance level is so low that it is sufficient to render a company incapable of promoting a project, or to make a project unattractive for private promotion. Anderson (1993) gives an example of this situation by stating that there are many countries where the possibility of having a privately promoted infrastructure project is excluded, regardless of the project characteristics, because of the perceived general political risk.

The delta factor is calculated by multiplying the delta of each of the m dominant model attributes δ_i

$$\delta = \prod_{i=1}^{m} \delta_i \quad (2)$$

That is, if the intensity of a dominant attribute falls below a certain threshold set by the decision maker (cutoff point), then its $\delta_i = 0$, otherwise $\delta_i = 1$. Hence, the δ of a project (or company) is equal to 1 only if all dominant attributes have intensities larger than their respective threshold levels. For the DM this threshold level is P1. Thus, $\delta_i = 0$ whenever a dominant attribute i has a performance level $x_i \leq$ P1 (i.e., whenever $v_i(x_i) = 0$).

The dominant attributes identified by the insiders and outsiders are indicated with a (*) in Table 2. For the insiders, 6/9 of the CC attributes and 12/14 of the PA attributes are dominant. The outsiders consider 8/9 of the CC attributes and all 14 PA attributes to be dominant. This clearly indicates that a project cannot be privately promoted if the performance of some of its attributes is very low, even if other attributes (including those with highest weights) have high performance levels. Projects must have some minimum performance levels across all attributes. The same applies to the characteristics of a company seeking to get involved in the private promotion of a project.

MODEL VALIDATION

The use of external criteria to objectively assess the validity of decomposed evaluation models is a difficult issue as multiattribute decision models are essentially subjective in nature. Therefore, past research has relied on indirect approaches, such as convergent validation, predictive validation, and axiomatic validation. The DM has been validated using the first of these methods.

Convergent validation consists of comparing the results obtained by a multiattribute decomposed model, such as the DM, with holistic (i.e., direct) evaluations made by the decision maker. Thus, several alternatives are defined (e.g., projects) and then evaluated by both the model and the decision maker. These evaluations are then compared as to how they rate and/or rank these alternatives. A high positive correlation between holistic and decomposed evaluations are expected to occur if, in fact, the decomposed model is capturing the decision maker's holistic evaluation preferences.

Von Winterfeldt and Edwards (1986) and Gardiner (1974) provide a summary of multiattribute decision models and show that typical correlations are in the range from 0.70 to 0.95. They interpret these findings as supporting the convergent validity of multiattribute decomposed models. Furthermore, they point out that these correlations tend to decrease as the number of attributes increases because the reliability of holistic judgments decreases as the number of model attributes increases. Even though the DM does use a large number of attributes, convergent validation of its results produced very high correlations that indicate its robustness and accuracy.

Convergent validation was performed by defining nine hypothetical company profiles and 10 hypothetical project profiles that were subsequently evaluated holistically by the experts on a scale from 0 to 100. The same profiles were also evaluated using both the DRM and EM and the results were subjected to statistical analysis.

The hypothetical project and company profiles provided a performance level for all model attributes and were designed to vary the CC and PA indices through a wide range so that the model's performance could be evaluated for companies and projects of diverse characteristics. They also ensured that all experts started out with the same information as the performance levels for all attributes of the project and company profiles were already given.

As an example, the project profiles used to validate the PA index are shown in Table 3. These profiles reflect the characteristics of 10 different projects from the viewpoint of one promoting company. The numbers in each project's column indicate the assumed performance level for the corresponding attribute using the qualitative scale in Fig. 2. For each expert, the decomposed evaluations $v(\bar{x})_{PA}$ given by (1) were calculated by transforming the performance level x_i of each of the project profile attributes into worth $v_i(x_i)$ (using P1 and P2 in Appendix III), and multiplying by the relative importance weights of the attributes w_i (Table 2). Since the sum of either the company or project attribute weights equals 1, and the worth scores are between 0 and 100, the calculated CC and the PA indices are also between 0 and 100.

The decomposed (DRM and EM) and holistic evaluations for all profiles were compared using Pearson's product-moment and Spearman's rank-order correlation coefficients. The resulting correlations for each *individual* expert range from moderate to strong and indicate that both decomposed models produce PA indices that are very close to the holistic evaluations. Similar results were obtained for the CC index (Dias 1994; Dias and Ioannou 1995). Group evaluations for the insiders and outsiders (for the holistic as well as the decomposed methods) were determined by averaging the individual PA indices and the CC indices for the experts within each group. The results for each *group*, evaluation method, and project or company profile are shown in Fig. 5.

It is clear from this figure that the PA and CC indices given by both decomposed models are very close to each other and to the holistic evaluations. This is not surprising as the weights assessed by the DRM and the EM are very similar, indicating that the two decomposition methods are practically equivalent. The correlation coefficients between the group weights encoded by using the DRM and the EM are shown in Table 4.

As expected, the high correlations between the weights given by the DRM and EM also leads to high correlations between the CC and PA indices produced by the two decomposition methods across the company and project profiles (Table 5).

In conclusion, the preceding results indicate that the DM captures the experts' holistic evaluations quite well, and that either decomposition method could be used to assess the attribute weights.

GROUP COMPARISON—INSIDERS VERSUS OUTSIDERS

The participating experts were divided into two groups to investigate potential differences in their points of view concerning the involvement of private-sector companies in the promotion of infrastructure projects. Both the weights as well as the evaluations of hypothetical profiles were compared for the two groups.

TABLE 3. Hypothetical Project Profiles

Project attractiveness attributes (1)	P1 (2)	P2 (3)	P3 (4)	P4 (5)	P5 (6)	P6 (7)	P7 (8)	P8 (9)	P9 (10)	P10 (11)
Character of promoting team's management	6	7	4	7	8	6	8	5	6	6
Strength of promoting team	8	8	5	8	7	7	7	6	6	7
Adequacy of promoters agreement	5	6	4	7	8	7	8	5	6	7
Ability to provide a quality design	7	9	7	8	7	6	8	6	7	8
Ability to provide a feasible construction plan	5	8	3	9	6	6	7	3	5	7
Ability to provide adequate operation-transfer package	7	9	5	8	7	6	7	3	6	6
Availability of adequate financial sources to raise financing	7	9	6	8	8	4	3	2	6	7
Financial viability	6	8	8	5	7	5	6	5	7	6
Certainty of construction and operation costs	6	8	6	7	7	6	6	4	5	8
Certainty of revenues	5	7	7	5	7	5	5	5	8	6
Overall quality of the principal	7	8	4	8	8	7	5	3	6	8
Level of community support	5	7	8	5	6	4	7	6	7	7
Legal environment	7	9	5	7	8	6	4	2	3	8
Political environment	8	8	3	9	8	7	5	2	3	7

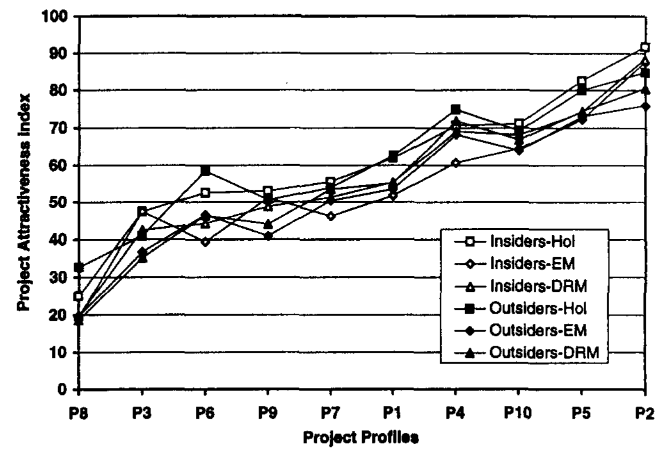

FIG. 5. Project Profile Evaluations—Comparison of Groups and Methods

TABLE 4. Correlation between Group Weights Assessed Using DRM and EM

Attributes (1)	Insiders (2)	Outsiders (3)
CC attributes	0.972	0.930
PA attributes	0.976	0.798

TABLE 5. Correlation between Evaluations for Hypothetical Company and Project Profiles Using DRM and EM

Index (1)	Pearson's Correlation Coefficient: Insiders (2)	Pearson's Correlation Coefficient: Outsiders (3)	Spearman's Rank Correlation Coefficient: Insiders (4)	Spearman's Rank Correlation Coefficient: Outsiders (5)
CC index	0.978	0.990	0.933	0.867
PA index	0.980	0.927	0.997	1.000

A comparison of the category and attribute weights showed a slight tendency for the insiders to pay more attention to the financial-related attributes, whereas outsiders focus more on the management part. These differences, however, did not prove to be statistically significant.

The PA evaluations for the 10 different hypothetical project profiles are shown in Fig. 5, for each group and for each evaluation procedure. It can be seen that the project evaluations for both groups are very close and follow a similar trend. Similar results were obtained when comparing the CC evaluations for the nine hypothetical company profiles.

TABLE 6. Correlation between Evaluations of Insiders and Outsiders for Hypothetical Company and Project Profiles

	Company Profile Evaluations		Project Profile Evaluations	
Evaluation method (1)	Pearson's correlation coefficient (2)	Spearman's rank correlation coefficient (3)	Pearson's correlation coefficient (4)	Spearman's rank correlation coefficient (5)
Holistic	0.969	0.952	0.897	0.817
Decomposed (EM)	0.922	0.891	0.955	0.900
Decomposed (DRM)	0.980	0.988	0.965	0.917

The correlation coefficients between the evaluations of the two groups are quite high and are shown in Table 6. Furthermore, for each of the three evaluation methods, and for every company and project profile, two-tailed Student t-tests were performed to check whether the indices given by the insiders had an average that was similar to the average evaluation by the outsiders. For all 57 tests, this hypothesis could not be rejected.

The preceding statistical results lead to the conclusion that there are no substantial differences between the group of insiders and the group of outsiders with respect to category and attribute weights. The same is true for company and project evaluations when all company and project attributes are set to the same performance levels for both groups (as was the case for the hypothetical profiles).

This conclusion, however, does not necessarily imply that the two groups would assess the same attribute performance levels when faced with a real company or project.

EXAMPLE PROJECT EVALUATION—THE EUROTUNNEL

The Eurotunnel is probably the most publicized and well-known example of a privately promoted project to date. As such, it was a good example of a real project that most of the participating experts would be familiar with and could evaluate without being given its explicit performance levels for the various project attributes.

In fact, all outsiders and six of the eight insiders felt they knew enough about the Eurotunnel to perform a meaningful project evaluation. The individual expert evaluations as well as the group evaluations for the Eurotunnel are shown in Table 7. Even though no general conclusions can be drawn based on the evaluation results for a single project, it appears that the two groups evaluate the project from different points of view. Insiders seem to assume a more conservative position and rate the project lower, perhaps because they have more at stake than the outsiders do.

The small differences between the group evaluations given by decomposed evaluations and the average holistic judgments confirm the previous conclusion that the PA index captures preferences of the decision makers. For the group of insiders, the differences between the PA index given by holistic assessment and each of the decomposed evaluations (EM and DRM) were 1.70 and 2.55 (out of 100 index points), respectively. For the group of outsiders the differences were 2.70 and 4.38 index points.

SENSITIVITY ANALYSIS—ATTRIBUTE WEIGHTS VERSUS WORTH SCORES

The evaluations for the Eurotunnel can also be used to investigate the sensitivity of the PA index $v(\bar{x})_{PA}$ to its constituents, that is, the composite attribute weights w_i, and the attribute worth scores $v_i(x_i)$. Table 8, shows the PA index for the Eurotunnel as determined for each expert using one of three different computational alternatives, A, B, or C. These alternatives are described at the bottom of Table 8. (Notice that alternative C should never be used to compute a PA or CC index as it is wrong to calculate group results by averaging the assessments of P1 and P2 or by averaging the performance levels of the attributes given by each expert. This alternative is shown here only to illustrate the sensitivity of the DM to different attribute importance weights.)

Alternative A (where both the worth scores and attribute weights vary from expert to expert) and alternative B (where the worth scores vary but attribute weights are constant) show almost the same variability ($V_A = V_B = 48\%$ for the insiders, and $V_A = 55\%$ $V_B = 54\%$ for the outsiders). In contrast, alternative C (where the worth scores are constant but attribute weights vary) has much smaller variability ($V_C = 8\%$ for the insiders, and $V_C = 4\%$ for the outsiders).

These results indicate that the PA index is liable to be much more sensitive to the attribute worth scores $v_i(x_i)$ (i.e., the assessment of P1 and P2, and the attribute performance levels x_i for the given project) than to the attribute importance weights w_i. Stillwell et al. (1981) obtained similar evidence from their analysis of alternative sources of energy. The prac-

TABLE 7. Attribute Performance Levels and Holistic and Decomposed Evaluations for Eurotunnel

Attribute/Evaluation Method (1)	I-01 (2)	I-02 (3)	I-03 (4)	I-05 (5)	I-06 (6)	I-07 (7)	O-01 (8)	O-02 (9)	O-03 (10)	O-04 (11)	O-05 (12)	O-06 (13)	Group of insiders (14)	Group of outsiders (15)
Character of promoting team's management	6	7	5	8	4	8	6	4	6	8	9	9	6.33	7.00
Strength of promoting team	5	7	6	7	4	8	8	4	6	8	9	7	6.17	7.00
Adequacy of promoters agreement	3	5	5	5	6	6	9	4	5	5	9	7	5.00	6.50
Ability to provide a quality design	8	7	5	5	8	6	7	7	6	6	9	8	6.50	7.17
Ability to provide feasible construction plan	7	5	3	5	8	6	7	6	6	8	9	9	5.67	7.50
Ability to provide adequate operation-transfer package	7	7	5	6	5	6	9	6	4	7	7	8	6.00	6.83
Availability of adequate financial source to raise financing	5	2	4	6	8	8	8	5	6	8	9	9	5.50	7.50
Financial viability	5	5	2	7	8	9	9	6	6	6	9	9	6.00	7.50
Certainty of constructability and operational costs	2	2	1	4	7	8	8	3	3	4	9	7	4.00	5.67
Certainty of revenues	5	7	1	6	7	8	8	3	5	4	9	7	5.67	6.00
Overall quality of the principal	2	5	3	7	3	8	7	7	7	9	9	8	4.67	7.83
Level of community support	6	6	6	7	6	7	5	5	5	7	9	9	6.33	6.67
Legal environment	7	7	4	7	5	7	5	7	5	9	9	9	6.17	7.33
Political environment	8	6	3	5	6	7	5	6	6	9	9	9	5.83	7.33
Holistic judgments	40.0	65.0	40.0	60.0	70.0	60.0	50.0	50.0	75.0	75.0	90.0	80.0	55.83	70.00
Decomposed evaluations—EM	39.4	43.8	7.4	78.1	81.7	94.8	89.5	1.6	43.2	76.6	99.6	93.3	57.53	67.30
Decomposed evaluations—DRM	43.0	50.3	14.7	73.7	76.5	92.1	83.0	2.9	42.8	74.6	99.2	91.2	58.38	65.62

TABLE 8. Alternative Computations of PA Index for Eurotunnel

(1)	Computational Alternative A[a] (2)	B[b] (3)	C[c] (4)
(a) Insiders			
I-01	43.0	34.3	44.8
I-02	50.3	51.2	45.9
I-03	14.7	16.9	44.4
I-05	73.7	65.7	45.2
I-06	76.5	70.2	39.7
I-07	92.1	89.6	37.0
Average	58.4	54.6	42.9
Standard deviation	28.0	26.2	3.6
Coefficient of variation	0.48	0.48	0.08
(b) Outsiders			
O-01	83.0	85.2	77.1
O-02	2.9	3.4	81.3
O-03	42.8	45.9	77.9
O-05	74.6	70.4	85.8
O-06	99.2	98.9	80.8
O-07	91.2	90.7	78.8
Average	65.6	65.7	80.3
Standard deviation	36.4	35.8	3.2
Coefficient of variation	0.55	0.54	0.04

[a]Alternative A—individual attribute importance weights (using the DRM), individual P1 and P2 assessments, individual attribute performance levels.
[b]Alternative B—group importance weights, individual P1 and P2 assessments, individual attribute performance levels.
[c]Alternative C—individual importance weights, group average P1 and P2 assessments, group average attribute performance levels.

TABLE 9. Rough Estimates for Index Thresholds

Evaluation Method (1)	Company Competencies Index: Insiders (2)	Company Competencies Index: Outsiders (3)	Project Attractiveness Index: Insiders (4)	Project Attractiveness Index: Outsiders (5)
Holistic	80.3	75.3	79.0	75.3
Decomposed (EM)	73.9	75.5	71.0	67.3
Decomposed (DRM)	78.7	77.3	74.0	69.8

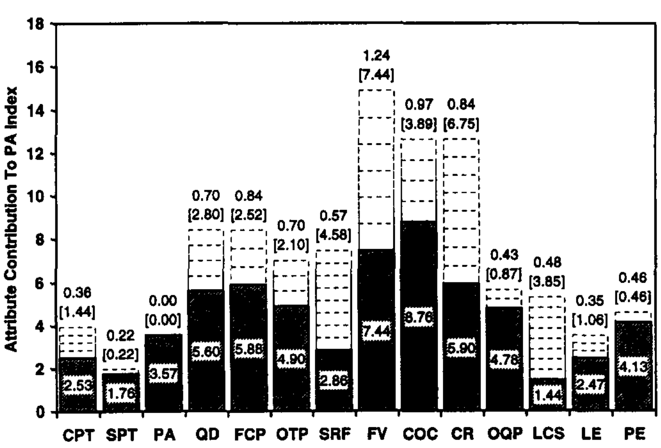

FIG. 6. Sensitivity Analysis Example: Attribute Contributions to PA Index of P6

tical implication of this conclusion is that real-world evaluations of projects or companies need not duplicate the substantial effort to reassess the attribute importance weights w_i given in Table 2. It is sufficient to establish the attribute performance levels x_i (which are project- and company-specific) and the points P1 and P2 that reflect the preferences of the decision maker.

CC AND PA INDEX THRESHOLDS

Table 9 is a compilation of the responses given by the participating experts as to what might be considered minimum acceptable thresholds for the CC and PA index. The decision to go forward, however, should not be based solely on these values as they have been developed from hypothetical company and project profiles and as such they represent only rough estimates.

DESIRABILITY MODEL AS SENSITIVITY ANALYSIS TOOL

The purpose of calculating a PA or CC index for a project or company is not simply to verify if it surpasses a certain minimum threshold so that a company may be considered well suited to participate in the promotion of an infrastructure project or for a project to be considered attractive for private promotion. The calculation of an index provides valuable information as to where effort should be concentrated for improving the most promising attributes of a company or project.

Using, for instance, the responses provided by expert "I-06" and the performance levels defined in project profile "P6" results in a PA index of 62.0. Fig. 6 is a graphical illustration of the actual and maximum attribute contributions to this index that helps to clarify the information contained in the index value. Individual attributes can be identified by their initials below the columns. The shaded part of each column represents the actual contribution of the attribute to the PA index. Each box at the top of a shaded column (shown with a dotted-line border) represents the extra contribution provided by that particular attribute if its performance level increases by 0.5. The two numbers at the top of each column represent the attribute's incremental contribution (i.e., the height of each dotted-line box) and its maximum additional contribution if its performance level increases from the current level to point P2.

Sensitivity analysis can be used to investigate how different incentives and risk mitigation strategies influence the model attributes. The use of the model improves the understanding of the weaknesses and strengths of the project and, hence, allows for better decision making. For instance, an inspection of Fig. 6 reveals that the attributes that can contribute the most to the improvement of the PA index are financial viability, certainty of revenues, availability of adequate financial sources to raise the financing, level of community support, and certainty of construction and operation costs. Therefore, efforts to improve the quality of the project should aim at increasing the performance level of these attributes. Some of the strategies that can enhance the performance of these attributes include: provision of a minimum-revenue guarantee, supply of long-term financing by the World Bank, utilization of local companies (in order to build some rapport between the local community and the project owning company), and use of lump-sum construction contracts.

CONCLUSION

Perhaps the best indication for the need to develop and implement a structured procedure for the evaluation of private-sector companies as potential project promoters, and the characteristics of infrastructure projects as candidates for promotion, is evidenced by the interest, enthusiasm, and generous contribution of knowledge, energy, and time for more than a year by the 14 experts that participated in this research.

The result of this effort is the DM, a multiattribute evaluation model that can be used to evaluate both projects and companies. At the conceptual level, the hierarchical structure of this model represent the experts' consensus and provides the 23 attributes that must be evaluated for any promoting company or candidate project.

The accuracy and robustness of the DM has been verified by the good agreement of its results (irrespective of the decomposition method used to establish attribute weights) and the experts' holistic evaluations for both projects and companies. This agreement also indicates that the two decomposition methods used to establish the composite weights for all attributes, the DRM and the EM, are essentially equivalent. Perhaps more important, is the conclusion that, at least in the initial stages, implementations of the DM need not use either method to reassess composite weights for the 23 attributes. Sensitivity analysis has shown that the composite weights provided in Table 2 are quite effective in representing the consensus of the entire group of participating experts. Thus, it may be sufficient to establish attribute performance levels (that are project- and company-specific) and one-dimensional value curves for each attribute that reflect the preferences of the decision maker.

The DM forces the decision maker to structure and separate the important problem dimensions, and provides a clear representation of the underlying attribute levels and values. Furthermore, the decomposition of the overall company and project evaluation into more manageable components provides a mechanism for sensitivity analysis and the generation of alternatives for improvement.

ACKNOWLEDGMENTS

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APPENDIX I. PARTICIPATING EXPERTS

The experts that participated in this study, in alphabetical order, and their professional affiliations at that time were

- Peter Berg (Manager, Eurorail Limited, U.K.)
- James Carroll (Vice President—Marketing and Planning Construction Group, Morrison Knudsen Corporation, U.S.)
- Yuven Cohen (Senior Economist, Parsons Brinckerhoff Quade & Douglas, U.S.)
- Roger Flanagan (Professor, University of Reading, U.K.)
- Ruth Flynn (Managing Consultant, Touche Ross, U.K.)
- Michael Harrison (Manager, Hines Interests Limited Partnership, U.S.)
- K. I. M. Hawwash (Lecturer, University of Birmingham, U.K.)
- Rik Joosten (Manager, Phillip Holzsmann, Germany)
- Jack Lemley (CEO, Transmanche Link, U.K.)
- Cliff Matson (Consultant, Australia)
- Bruce McKendry (Director of Development, HDR Inc., U.S.)
- Colin Stannard (Consultant, Finance for Enterprise Limited, U.K.)
- Robert Tiong (Senior Lecturer, Naygang Tech. University, Singapore)
- Donald Vuchetich (President, Detroit and Canada Tunnel Corporation, U.S.)
- Janet Yates (Associate Professor, Brooklyn Polytechnic University, U.S.)

APPENDIX II. ATTRIBUTE DESCRIPTIONS

Internal Organization Characteristics

- Quality of Management Team (QMT)—Assessment of the aptitude of the company's management team to handle the project. This includes (1) the presence of negotiation and political skills to negotiate and interact with the different partners; (2) the presence of the necessary skills to understand the complexity of the project and to select and acquire the right expertise; (3) past experience with similar projects; and (4) the existence of patience and resolve.
- Fitting of Strategic Planning (FSP)—Adequacy of the project in fulfilling corporate interests and objectives such as industry positioning (e.g., access to new markets and enhancement of corporate image), business expansion (or business survival in case of a weak market), and diversification of business line.
- Compatibility with Potential Partners (CPP)—Existence of similarities and synergy among potential partners.

Production Capability

- Adequacy of Specialized Knowledge (ASK)—Adequacy of the in-house expertise (technical, legal and/or financial) to properly handle the complexity and scope of the project tasks assigned to the company.
- Overall Quality of Productive Resources (QPR)—Evaluation of the characteristics, qualifications, and features of the company's productive resources (e.g., labor and equipment) to effectively perform the project tasks assigned to the company.
- Availability of Productive Resources (APR)—The company's ability to provide the necessary productive resources (e.g., labor and equipment) to be used during the project either by using its actual available capacity or by expanding its capacity level.

Financial Resources & Constraints

- Ability to Fund Initial Project Costs (FIC)—The company's ability to share with other promoting partners the expenditures that incur during the initial stages of the project (e.g., feasibility studies, preliminary design, proposal preparation, and bid submission).
- Ability to Supply Capital for the Project (SCP)—The company's ability to commit and provide its own financial resources to (1) help fund the project, normally through equity infusions; and (2) back its project operations (e.g., "fund" incurred costs that have not been paid or billed).
- Quality of Profitability (QP)—Assessment of the quality of the project return on the company's investment in terms of its expected amount, its certainty (risk profile), and its timing (dividend and sell-out policies).

Promoting Team Characteristics

- Character of Promoting Team's Management (CPT)—Promoters' ability to create a management team that acts as an "owner" and is capable of identifying strategies and pursuing objectives that enhance the project's likelihood of success rather than making decisions based on what is best for individual promoters.
- Strength of Promoting Team (SPT)—The capability of the promoting team to handle the project based on its engineering talent and expertise, facility-operating experience, in-country knowledge, local contacts, negotiating and political skills to interact with the principal ("client"), financial strength and expertise, knowledge of

competition, and the ability to identify and allocate risks to the participants best able to manage them.

- Adequacy of Promoters Agreement (PA)—Adequacy of the promoters agreement as a vehicle through which promoting partners work in cooperation to define the specific functions of each promoter and to structure the policies that govern the contract policies (e.g., transfer of shares, voting rights, dividend policy) and the operational details of the project (e.g., which project management system to use).

Technical Evaluation

- Ability to Provide a Quality Design (QD)—Promoters' ability to develop a design that (1) is compatible with the terms of the privatization or concession agreement (e.g., project capacity, life expectancy, and quality of services), with local legislation (i.e., meeting local standards and regulations), and with existing associated facilities; (2) is functional; and (3) uses known, proven, and reliable technology.
- Ability to Provide a Feasible Construction Plan (FCP)—Promoters' ability to provide a construction plan that is sensitive to the duration of the construction period while considering the final quality of the facility, the availability of labor, materials, and equipment for the construction of the facility.
- Ability to Provide an Adequate Operation-Transfer Package (OPT)—Promoters' confidence in their ability to offer (1) operational methods that are simple and efficient and that consider the availability of skilled personnel to operate the facility, training programs, the availability of raw materials necessary to run the facility, and the planning of time allowances for major maintenance work; and, in "finite-concession" projects, (2) a transfer strategy that considers the training of client personnel, the quality of the facility at the time of transfer, and optional provisions that allow the client to sell the facility to the promoters or to further extend the concession period.

Financial Assessment

- Availability of Adequate Financial Sources to Raise the Financing (SRF)—Assessment of the availability of adequate financial sources to fund the project. It considers (1) the existence of a well-developed local capital market (e.g., possibility to raise long-term funds from local commercial sources); (2) the availability of loans and export credits from international commercial lenders and international financing institutions (e.g., the World Bank, EBRD, and international credit agencies) to supplement equity and local debt; and (3) the availability of the necessary financial instruments used to structure the financial package.
- Financial Viability (FV)—Assessment of the project's capacity to service principal and interest payments on the project debt over the term of the various loans and to provide a return on equity that is commensurate with whatever development and long-term project risks the equity investors are being asked to take.
- Certainty of Construction and Operational Costs (COC)—Assessment of the certainty (i.e., risk profile) of the construction, operational, and maintenance costs. It considers the promoter's cost exposure to (1) uncertainties in the scope of work; (2) construction and operational risks (such as construction delays, cost overruns, contractor performance, unforeseen physical and weather conditions, accidental damage, and failure of equipment); (3) the conditions of existing facilities that have been transferred to the promoters; and (4) alterations on macroeconomic factors (such as inflation, interest rates, and currency exchange rates).
- Certainty of Revenues (CR)—Assessment of the certainty (i.e., risk profile) of the project revenues. It considers the project's income potential and uncertainty based on (1) demand forecasts; (2) the duration of the concession; (3) the identification of specific revenue streams; (4) the availability of revenues before construction completion; (5) the availability of commercial freedom to set and adjust utility (toll) prices; (6) the existence of other competing facilities; (7) the provision of contract led revenues; (8) the quality of receivables (i.e., the creditworthiness of the future users/tenants of the facility); (9) the elasticity of utility (toll) prices; and (10) alterations on macroeconomic factors (such as inflation, interest rates, and currency exchange rates).

Principal's Qualification & Local Conditions

- Overall Quality of the Principal (OQP)—Assessment of the overall quality of the principal (i.e., client) of the project. It considers (1) the ability of the principal to provide financial (e.g., guarantees and standby financing) and logistical support; (2) the creditworthiness of the principal; (3) the integrity of the "procurement process" (e.g., the existence of an unbiased evaluation of the different proposals, the timeliness of the tendering and negotiating phases, and the implementation of agreements that spell out in detail the support to be provided by the principal and the rights and obligations of the project-owning company); and (4) the existence of a body formed by high rank (principal's) personnel that have the will and determination to "get the job done" and the necessary authority to commit their agencies/companies to the terms of the negotiations with the promoting team in a timely manner.
- Level of Community Support (LCS)—Assessment of the public support and acceptance of the project and its implications regarding user-pay policy (e.g., user resistance to pay tolls or user ineptitude to pay nonsubsidized utilities), foreign ownership of assets, and environmental concerns.
- Legal Environment (LE)—Assessment of the maturity and reliability of the local basic legal and regulatory systems (e.g., labor and tax laws) and also of the particular legal and regulatory systems that regulate concession-financed projects and enforce concession contracts (e.g., legislation regarding the private ownership of assets, land acquisition, investment rules, toll and tariff indexation arrangements, and environmental concerns).
- Political Environment (PE)—Assessment of the political stability of the host country. It considers (1) the possibility of governments to take actions that directly affect the profitability level of the project (e.g., changes in environmental laws, taxation and controls on equity, repatriation of funds, fiscal and monetary controls, and exchange mechanisms; interference in operations and tariff policy; nationalization; and expropriation); and (2) the likelihood of having significant changes in the political regime or significant levels of political inspired violence (e.g., possibility of riots, terrorism, general strikes, and wars).

APPENDIX III. POINTS P1 AND P2 FOR ATTRIBUTE VALUE FUNCTIONS

TABLE A.1. Points P1 and P2 for All Attributes—Insiders' Assessments

Attribute	I-01		I-02		I-03		I-04		I-05		I-06		I-07		I-08	
(1)	P1 (2)	P2 (3)	P1 (4)	P2 (5)	P1 (6)	P2 (7)	P1 (8)	P2 (9)	P1 (10)	P2 (11)	P1 (12)	P2 (13)	P1 (14)	P2 (15)	P1 (16)	P2 (17)
(*a*) Internal organization characteristics																
Quality of management team	6.0	7.5	3.0	8.0	3.5	7.0	7.0	9.0	4.0	7.0	3.5	7.5	4.0	8.0	3.5	6.5
Fitting of strategic planning	4.0	6.5	3.0	7.0	5.0	5.5	4.0	6.5	2.0	6.0	3.0	7.0	3.0	7.0	3.5	5.5
Compatibility with potential partners	5.0	7.0	3.0	7.0	4.0	6.0	7.0	9.0	2.5	6.0	3.5	7.5	3.0	7.0	4.0	7.0
(*b*) Production capability																
Adequacy of specialized knowledge	6.0	7.5	3.0	8.0	3.0	7.0	5.0	8.0	3.5	6.0	3.0	7.5	3.0	8.0	6.5	7.5
Overall quality of productive resources	3.5	6.5	3.0	7.0	4.0	5.5	7.0	9.0	2.0	7.0	2.5	7.5	3.0	7.5	3.5	5.5
Availability of productive resources	2.5	6.0	3.0	7.0	3.0	6.5	4.5	7.5	2.0	7.0	2.5	7.5	3.0	7.0	7.0	8.0
(*c*) Financial resources and constraints																
Ability to fund initial project costs	4.0	7.0	4.0	8.0	2.0	8.0	5.0	7.5	4.0	8.0	2.5	7.0	2.5	6.5	3.0	7.0
Ability to supply capital for project	3.0	7.0	3.0	7.0	3.0	7.5	6.0	9.0	3.0	8.0	3.0	8.0	2.5	6.5	3.0	5.5
Quality of profitability	6.5	8.0	5.0	9.0	3.0	7.0	5.0	9.0	4.0	6.5	2.5	8.0	4.0	8.0	7.0	8.5
(*d*) Promoting team characteristics																
Character of promoting team's management	4.0	7.5	3.0	7.0	3.0	6.0	6.0	8.5	4.0	7.0	2.5	8.0	3.0	7.5	3.0	6.0
Strength of promoting team	6.0	7.5	3.0	7.0	4.0	7.0	6.0	8.5	4.0	7.5	3.0	7.5	3.5	8.0	6.5	8.5
Adequacy of promoters agreement	4.0	7.5	3.0	7.0	4.5	8.0	5.5	8.0	2.0	6.0	3.0	7.0	3.5	7.5	4.5	5.5
(*e*) Technical evaluation																
Ability to provide a quality design	4.5	7.0	4.0	8.0	4.5	7.0	5.5	8.0	2.5	8.0	2.0	8.0	3.0	7.5	6.5	8.5
Ability to provide a feasible construction plan	4.0	7.5	4.0	7.0	4.0	7.5	4.0	7.5	2.5	7.5	2.5	7.5	3.0	7.5	7.5	8.5
Ability to provide adequate operation-transfer package	4.0	7.5	3.0	7.0	2.5	7.0	5.5	8.5	2.0	8.0	2.5	7.5	3.0	7.5	4.5	5.5
(*f*) Financial assessment																
Availability of adequate financial sources to raise financing	5.5	8.0	5.0	8.0	4.5	8.0	7.0	9.0	3.5	8.0	1.5	8.0	3.0	8.0	7.0	8.5
Financial viability	6.5	8.0	5.0	8.0	4.0	8.5	7.0	9.0	3.5	8.5	2.0	8.0	4.0	8.5	7.0	8.5
Certainty of construction and operation costs	5.5	8.0	4.0	8.0	4.0	8.0	7.0	9.0	2.5	6.5	1.5	8.0	3.0	7.0	6.5	7.5
Certainty of revenues	5.5	8.0	4.0	8.0	4.0	8.0	7.0	9.0	3.0	7.5	1.5	9.0	3.0	7.5	7.0	9.0
(*g*) Principal's qualification and local conditions																
Overall quality of principal	5.5	8.0	3.0	7.0	4.0	7.0	7.0	8.0	3.0	8.5	1.5	8.0	3.5	8.0	3.5	7.0
Level of community support	3.5	7.0	4.0	8.0	4.5	8.0	4.5	7.0	2.5	7.0	2.5	8.0	2.5	6.5	5.5	8.0
Legal environment	5.5	8.0	3.0	7.0	3.5	6.5	4.5	7.0	4.0	7.5	2.5	7.5	3.5	8.0	6.0	8.0
Political environment	5.5	8.0	4.0	8.0	3.5	6.5	4.5	7.0	4.0	8.5	2.5	7.5	3.0	8.0	6.5	8.5

TABLE A.2. Points P1 and P2 for All Attributes—Outsiders' Assessments

Attribute	O-01		O-02		O-03		O-04		O-05		O-06	
(1)	P1 (2)	P2 (3)	P1 (4)	P2 (5)	P1 (6)	P2 (7)	P1 (8)	P2 (9)	P1 (10)	P2 (11)	P1 (12)	P2 (13)
(*a*) Internal organization characteristics												
Quality of management team	4.5	6.5	6.5	8.0	2.5	7.5	4.0	8.0	4.0	8.0	6.5	7.5
Fitting of strategic planning	4.5	5.5	4.0	7.0	3.5	7.5	3.0	6.0	2.0	6.0	4.5	6.5
Compatibility with potential partners	4.5	5.5	5.0	7.0	3.5	7.5	3.0	7.0	3.0	8.0	7.5	8.5
(*b*) Production capability												
Adequacy of specialized knowledge	3.5	6.5	3.5	6.5	3.5	7.0	3.0	7.0	4.0	8.0	5.5	7.5
Overall quality of productive resources	4.5	6.5	3.5	6.5	3.5	7.5	3.0	7.0	3.0	8.0	5.5	7.5
Availability of productive resources	3.5	4.5	3.5	6.5	3.5	7.5	2.0	6.0	3.0	8.0	4.5	6.5
(*c*) Financial resources and constraints												
Ability to fund initial project costs	4.5	6.5	7.5	8.5	3.0	7.0	4.0	7.0	4.0	8.0	7.5	8.5
Ability to supply capital for the project	4.5	5.5	5.0	7.0	3.5	7.0	2.0	6.0	4.0	8.0	7.5	8.5
Quality of profitability	6.5	7.5	7.0	8.0	3.5	7.0	4.0	8.0	3.0	8.0	6.5	8.5
(*d*) Promoting team characteristics												
Character of promoting team's management	4.5	5.5	7.5	8.5	3.0	7.0	4.0	8.0	4.0	8.0	6.5	8.5
Strength of promoting team	4.5	5.5	6.0	7.5	3.0	7.5	3.0	7.0	4.0	8.0	5.5	7.5
Adequacy of promoters agreement	6.5	7.5	6.5	8.0	3.0	6.5	4.0	8.0	4.0	8.0	4.5	7.5
(*e*) Technical evaluation												
Ability to provide a quality design	5.5	7.5	8.0	9.0	4.5	7.0	3.0	8.0	4.0	8.0	5.5	7.5
Ability to provide a feasible construction plan	3.5	4.5	8.0	9.0	4.5	6.0	3.0	8.0	4.0	8.0	7.5	8.5
Ability to provide adequate operation-transfer package	4.5	5.5	7.0	8.0	4.0	8.0	3.0	7.0	4.0	8.0	5.5	8.5

TABLE A.2. (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(*f*) Financial assessment												
Availability of adequate financial sources to raise financing	4.5	5.5	8.0	9.0	4.0	8.0	4.0	7.0	4.0	8.0	5.5	7.5
Financial viability	2.5	3.5	8.5	9.0	5.0	9.0	5.0	8.0	4.0	8.0	4.5	8.5
Certainty of construction and operation costs	2.5	3.5	6.5	8.0	5.0	7.0	3.0	7.0	4.0	8.0	4.5	7.5
Certainty of revenues	1.5	2.5	6.5	8.0	7.0	9.0	4.0	8.0	4.0	8.0	4.5	7.5
(*g*) Principal's qualification and local conditions												
Overall quality of the principal	3.5	4.5	7.0	8.5	5.0	7.0	3.0	7.0	4.0	8.0	7.5	8.5
Level of community support	4.5	6.5	7.0	8.0	4.0	8.0	4.0	7.0	3.0	7.0	7.5	8.5
Legal environment	4.5	6.5	6.0	8.0	3.5	7.0	3.0	6.0	3.0	7.0	7.5	8.5
Political environment	4.5	5.5	6.5	8.0	5.5	7.5	4.0	7.0	4.0	8.0	7.5	8.5

APPENDIX IV. REFERENCES

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