Improving decision quality: a risk-based go/no-go decision for build–operate–transfer (BOT) projects

Jong H. Ock, Seung H. Han, Hyung K. Park, and James E. Diekmann

Abstract: The build–operate–transfer (BOT) mechanism is used worldwide to promote diverse infrastructure projects. Success in BOT projects mainly depends on selecting the right project to promote. The right project selection initiates from identifying a presumably viable project to pursue at the early project initiation process. When deciding on a prospective project to pursue, developers in many cases rely on their judgment, intuition, or rules of thumb rather than analytic evaluation of the complex BOT characteristics and specific project conditions. It is expected that they will improve the quality of their decisions if a methodical formalism is provided that can help systematically recognize (*i*) risk factors in the BOT project environment, (*ii*) the impact of these decisions on project feasibility, and (*iii*) strategic alternatives to enhance these decisions. The main objective of this research is to develop a risk-based, go/no-go decision model as the formalism, which consists of a decision process model and a decision variables relationship model. A numerical example is presented to demonstrate the computational procedures of the model. In an effort to validate the model, this research invites 60 test subjects and adopts convergent experimental studies.

Key words: build–operate–transfer, go/no-go decision, decision quality, multi-attribute decision-making, convergent validation.

Résumé : Le mécanisme de construction-exploitation-transfert (BOT) est utilisé dans le monde entier pour promouvoir divers projets d'infrastructure. Pour réussir les projets BOT, il faut choisir le bon projet à promouvoir. Cette sélection découle de l'identification d'un projet probablement viable à pousser lors du début du processus d'initiation du projet. Lors de la décision sur un projet intéressant à pousser, dans plusieurs cas les promoteurs se fient sur leur jugement, leur intuition ou des règles empiriques plutôt que sur une évaluation analytique des caractéristiques BOT complexes et des conditions spécifiques du projet. Les promoteurs pourraient accroître la qualité de leurs décisions si un formalisme méthodologique est fournit pour les aider à reconnaître systématiquement les facteurs de risque dans l'ensemble du projet BOT, leur impact sur la faisabilité du projet et d'autres stratégies pour les améliorer. L'objectif principal de cette recherche est de développer un modèle de décision oui/non basé sur le risque pour servir de formalisme, qui consiste en un modèle de prise de décision et d'un modèle de relation des variables de décision. Un exemple numérique est présenté pour démontrer les procédures calculatoires du modèle. Afin de valider le modèle, la présente recherche sollicite 60 sujets expérimentaux et a recours à des études expérimentales convergentes.

Mots clés : construction-exploitation-transfert, décision oui/non, qualité de la décision, prise de décision multi-attributs, validité concourante.

[Traduit par la Rédaction]

Introduction

The build–operate–transfer (BOT) project delivery method is a highly integrated approach where developers are required to (*i*) select a feasible project; (*ii*) form a consortium company; (*iii*) prepare a proposal; (*iv*) participate in a competitive proposal-tendering process; and, if the project is contracted, (*v*) design, finance, construct, own, and operate the project for a specific period of time (i.e., concession period); and then (*vi*) transfer the ownership of the project to the government (Williams and Conrad 1996).

Tiong et al. (1992) described six critical success factors of BOT projects: entrepreneurship, right project selection, strong consortium team, imaginative technical solutions, competitive financial proposals, and special features in the bid. Researchers have emphasized that, among these factors, the right project selection is ranked by developers as one of the most important tasks (Tiong 1995).

Received 19 January 2004. Revision accepted 4 January 2005. Published on the NRC Research Press Web site at http://cjce.nrc.ca on 31 May 2005.

J.H. Ock. Department of Architectural Engineering, Seoul National University of Technology, Seoul 139-743, Korea.
S.H. Han.[1] Department of Civil and Environmental Engineering, Yonsei University, Seoul 140-324, Korea.
H.K. Park. Daewoo Engineering and Construction Co. Ltd., Seoul 140-324, Korea.
J.E. Diekmann. Department of Civil, Environmental & Architectural Engineering, University of Colorado at Boulder, Boulder, CO 80309-0428, USA.

Written discussion of this article is welcomed and will be received by the Editor until 31 October 2005.

[1]Corresponding author (e-mail: shh6018@yonsei.ac.kr).

 doi: 10.1139/L05-002

In the BOT mechanism, four different types of project initiation processes are implemented (KRIHS 1998). This categorization is based on which party initiates a project, namely the government or developer, and what document the government initially issues, the request for qualification (RFQ) and the request for proposal (RFP) either at the same time or separately. When the government initiates a project, it is called "government programmed." A project is referred to as "privately invented" when it is started by developers.

The right project selection involves the identification of a presumably viable project to pursue (hereafter referred to as go/no-go decision) at the very up front project initiation process. The decision should be made as early as possible because it is a disaster for developers to find out the project is not economical or politically unacceptable after spending millions of dollars in the proposal development process.

During the early stage of BOT project development, however, there is insufficient information available to measure project viability. Although many more risks are involved in BOT projects than conventional construction, and their impact ruins project feasibility, it is very difficult to recognize which risk variables critically influence these projects. Consequently, making the go/no-go decision becomes a matter of subjective judgment based on a developer's experience, intuition, or rules-of-thumb rather than a systematic evaluation of the specific project conditions, often leading developers to choose improper projects to go.

Many professionals emphasize the importance of risk management to be successful in BOT projects. Measuring project viability at the early project initiation stage is not an exact science. It is an art. Two different developers may approach the same project very differently. It is important to note a broad range of patterns among the different approaches, however, and to prepare a prescriptive formalism as a methodology that supports developers to make correct choices, thereby enhancing the possibility of project success.

The main objectives of this paper are (*i*) to suggest the multi-attribute decision analysis method (MADAM) as an appropriate theoretical methodology to formalize the go/no-go decision context of BOT projects; and (*ii*) to develop and validate the go/no-go decision model that helps developers evaluate the preliminary viability of a BOT project to pursue at the very early stage of the project development process.

Among a variety of infrastructure systems, toll road projects are selected as an appropriate problem domain where the model is desirable. Many professionals anticipate that the toll road and toll bridge market will expand greatly as both the public and private sector gain an increased understanding of the BOT mechanism. In fact, more than 480 private toll road projects, valued at CAN$3 trillion, are being considered or constructed worldwide, which accounts for 48% of privatized construction projects (Public Works Financing 1998).

Research scope

Different project initiation processes lead different decision-making procedures. Among the four types of BOT project initiation processes stated earlier, this paper focuses on the process where the government initiates a project and simultaneously issues the RFQ and RFP. This process is relatively simple compared to the three others and is appropriate when a small number of developers intend to participate in the project promotion (Gomez-Ibanes and Meyer 1991). The Ministry of Construction and Transportation (MOCT) in Korea has used this method to promote 13 toll highway projects since 1995 (KRIHS 2002).

Figure 1 illustrates the generic BOT project procurement procedures in association with the project initiation process assumed in this paper. Referring to the gray boxes in Fig. 1, it is understood that to make the go/no-go decision for the project under consideration, the developers need to identify qualified consortium partners who can satisfy their needs for the project and measure prospective viability of the project from the perspective of both themselves and the partners.

Research methodology

As an initial step to meet the research objectives, this paper identifies the characteristics of the go/no-go decision through literature review. Previous research papers that have dealt with BOT decision models are then reviewed to investigate the models that will address the go/no-go decision features and those which are useful to measure project feasibility. Diverse decision theories are examined to find a proper theoretical methodology for overall modeling of the go/no-go decision context. The MADAM is developed as a relevant modeling tool.

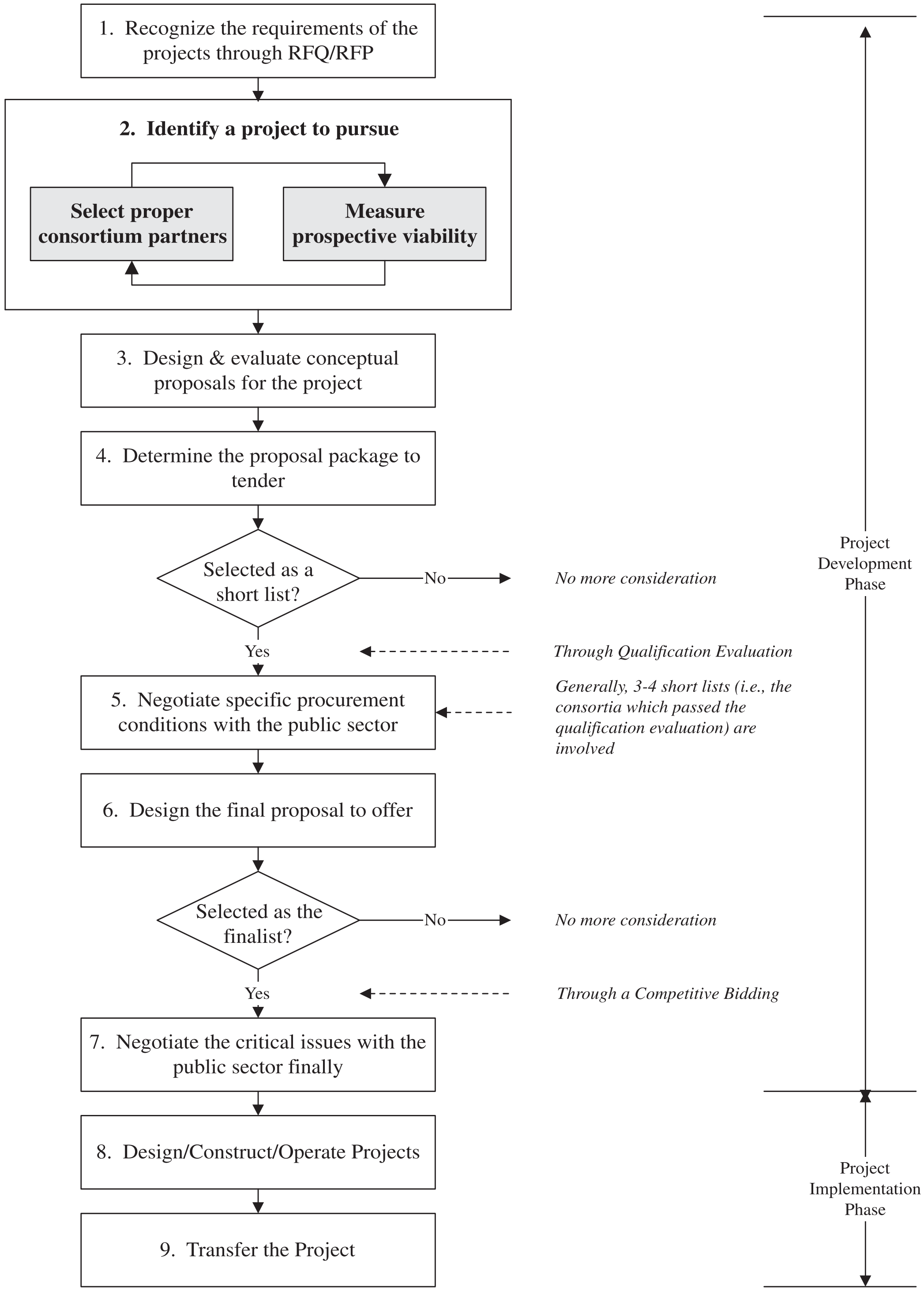
The go/no-go decision model, built up by the use of MADAM, consists of a decision process model and a decision variables relationship model. Extensive literature review and case studies are performed to identify risk factors and decision attributes in the relationship model. A numerical example is prepared to demonstrate and verify the computational aspects of the model.

The last step of this research is to validate the model. Although the model is developed to offer a prescriptive guideline to improve decision quality in selecting a presumably viable BOT project to go at the up-front project development process, objectively assessing the validity of the model in a laboratory scheme is quite difficult, since a multi-attribute decision model is essentially subjective and judgmental in nature. Case study methodology is chosen as a proper validation approach to the research features. Three BOT highway projects were identified as the case study materials, and 60 test subjects were invited from three different sources to test if the model improved decision quality.

Characteristics of the go/no-go decision

There are four factors (Clemen 1996) that complicate a decision problem: (*i*) uncertainty, (*ii*) decision sequence, (*iii*) multiple alternatives, and (*iv*) multiple interests. Through literature review, this paper identifies that the go/no-go decision for a BOT project includes these four factors. These elements must be integrated into the go/no-go decision formalism. The following is a brief explanation of their involvement in the decision.

Fig. 1. Generic procurement procedures of the BOT projects.



Decision under uncertainty

As stated earlier, in identifying a preliminary viable project at the up-front project development process, there is very limited information available. Also, developers are not allowed enough time to investigate more reliable information for the decision. Most public agencies require submitting a BOT proposal within 150–180 days after issuing the RFP (Gomez-Ibanes et al. 1991). The developers need to make a go/no-go decision within a month or less despite the complex skein of uncertainties involved.

Sequential decisions

There are five sequential decisions the developers need to make when developing a BOT proposal (Augenblick et al. 1990): (*i*) Is a project good enough to choose? (*ii*) How big can the project be? (*iii*) How much money is needed?

(*iv*) How much money can be borrowed based on the prospective revenue from the project? and (*v*) Is it necessary to enhance project credit quality to borrow more money for the project?

Although the first decision is similar to step 2 in Fig. 1, the developers need to make four other decisions iteratively in the proposal development process. There are two iterative decision procedures from the perspective of the developer. The first is to design the most favorable proposal to tender (steps 3 and 4 in Fig. 1); and the second is, after being selected as one of the short lists and negotiating specific procurement conditions with the public sector, to develop the best and final proposal to offer (step 6 in Fig. 1). During the process, the risk factors that have been considered in the first decision are to be reexamined to measure the possible improvement of project feasibility while gathering more information.

Multiple alternatives

Whereas the go/no-go decision prevents developers from committing millions of dollars to unacceptable projects, developers should have a positive outlook when evaluating prospective projects so as to maintain the continuous growth, thereby enhancing current project opportunities. Expectedly, no BOT project can be ensured to be definitely successful at its beginning stage. Therefore, developers need to prepare multiple strategic alternatives and develop negotiation plans that allow for improving project feasibility by controlling and reducing the impact of the risk factors in the project context.

Multiple interests

When determining a feasible project to go, developers need to carefully measure if a prospective project can satisfy the interests of other project participants, especially public agencies and financial institutions, while still maintaining their potential profit. In general, the interests of the two entities in the BOT projects are well expressed in their BOT proposal evaluation guidelines. Numerous researchers (Price Waterhouse 1993; Gomez-Ibanes and Meyer 1991; Gonzalez-Ayala et al. 1993) conceptualized the guidelines into 10 evaluation criteria based on their characteristics and defined their relevance to the five sequential decisions as shown in Fig. 2. They also identified that the seven criteria, depicted as gray boxes in Fig. 2, should be emphasized more to meet interests, particularly when developing a proposal to tender. This configuration effectively presents multi-interest problems in the go/no-go decision context.

Existing approaches for BOT project evaluation

The authors reviewed previous decision models in the BOT domain area to identify if suitable ones were available to apply to the go/no-go decision. Dias and Ioannou (1996) developed the desirability model (DM), where 24 variables (e.g., legal environment, financial viability, certainty of revenue, quality of management team, level of community support) are involved as a multi-attribute decision model for assessing the capacity of developers and the attractiveness of a BOT project. Although it does a good job of addressing a multicriteria decision context, the model does not include a supportive mechanism for developers to realize diverse relationships of numerous risk variables, which is essential to develop strategic options for improving project feasibility.

Diekmann and Ashley (1994) produced the MK scoring table, where nine decision attributes are manipulated to screen potentially suitable BOT projects. Although the tool is excellent in terms of its simple and straightforward approach to representing a multicriteria decision problem, it simply considers the decision problem deterministic as a whole.

Tiong (1996) developed the competitive proposal tendering and negotiation model for BOT developers. Although the model identifies 24 decision-influencing factors (e.g., public safety, short concession period, accurate prediction of critical need, lack of funds by government, short construction period) and intends to combine the sequential BOT proposal development processes (i.e., conceptual, confirming, and winning proposal) with the factors, it only provides a macro view of which factors are related to what process, without describing the relationship of the factors and the uncertainties involved.

A few authors have developed analytic methodologies to evaluate the financial feasibility of infrastructure projects (Brzozowski et al. 1977; Kim et al. 2002). The methods, however, merely focus on the economic potential of a project based on cash flows without addressing multiqualitative concerns and uncertainty in the decision problem.

Theoretical framework of modeling tool

Review of relevant decision theories

Recognizing the shortcomings of existing approaches, this paper suggests the risk-based go/no-go decision model. To identify proper theoretical tools to model the go/no-go decision context, the writers reviewed the following approaches among a number of decision theories, which in part make up a suitable mechanism to address the characteristics of the go/no-go decision problem: decision analysis (DA), multi-attribute decision models (MADM), and prescriptive choice modes.

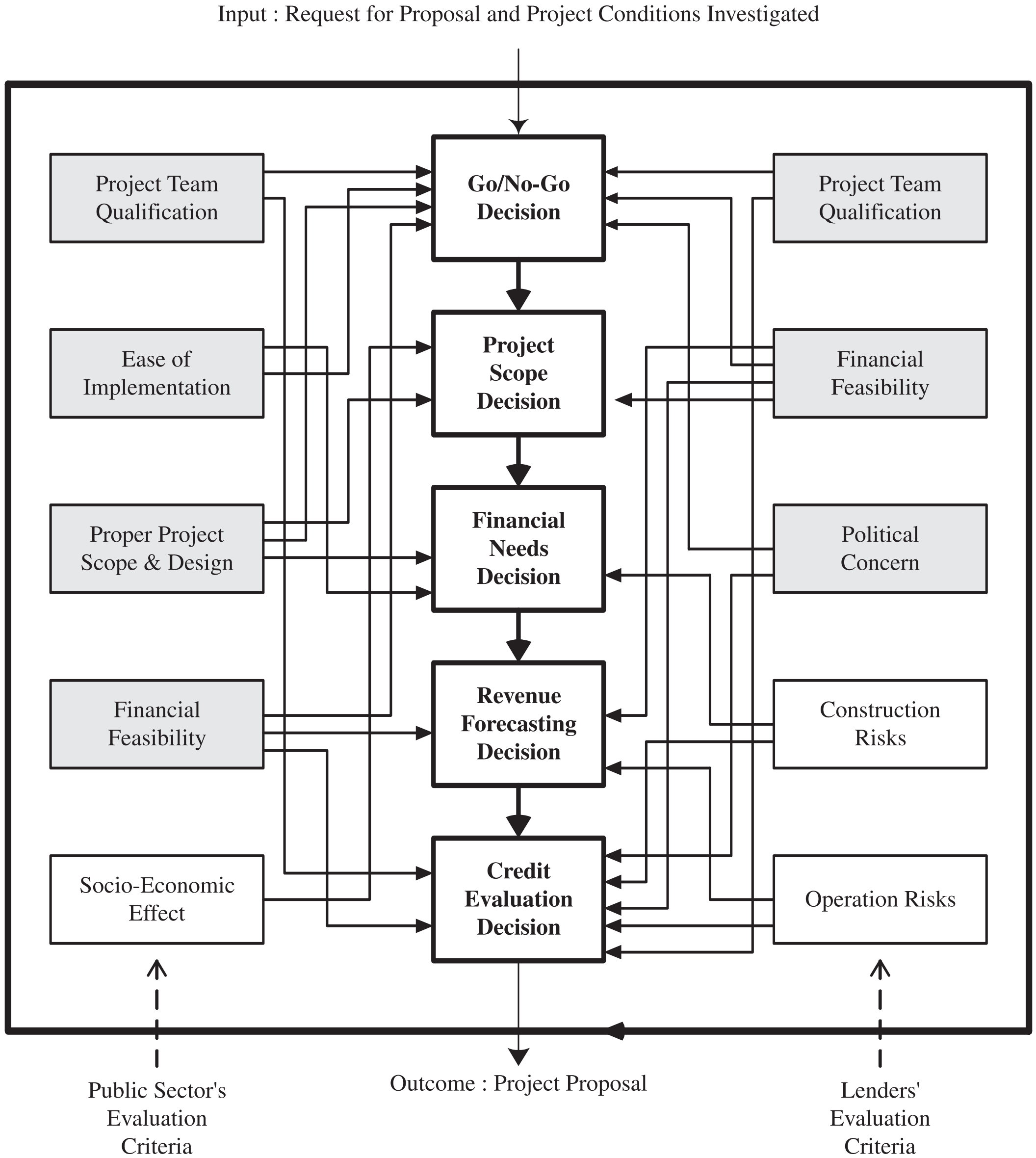
Decision analysis (DA)

Decision analysis (DA) is the only quantitative approach to deal with decision-making under risk or uncertainty (Bell et al. 1988). It provides a normative formalism with a mathematical framework that is based on the principles of probability theory to represent uncertainty and the expected utility maximization as a choice mode. Although a few authors suggest that DA is the unique method that enhances decision quality under uncertainty (Matheson 1992), a number of different theorists criticize that it is impractical and difficult to understand because of the challenge in measuring the utility function of the decision-makers (Call and Miller 1990).

Multi-attribute decision models (MADMs)

MADMs are designed to solve decision problems that involve conflicting objectives (Keeney and Raiffa 1993). Currently, two MADMs are available: multi-attribute utility theory (MAUT), and simple multi-attribute rating technique

Fig. 2. Relevance of the BOT proposal evaluation criteria to the five decisions.



(SMART). In both methods, the options in decision-making are described by multiple attributes with a scalar value to show their performance level in meeting the decision objectives. The difference is that MAUT needs a utility function for each attribute, whereas SMART employs a direct utility value on a cardinal scale for the attributes.

Although MAUT has been recognized as impractical and hard to use due to the complex nature of developing the utility functions like DA (Green 1992), the simple and practical procedures of SMART have been successfully demonstrated in construction projects. These include (*i*) identifying decision options and attributes, (*ii*) eliciting a hierarchical value structure of the attributes that can effectively meet multi-criteria decision requirements, (*iii*) assigning importance weights to each of the lower order attributes of the value structure, (*iv*) assessing each option against the attributes at the lowest level of the structure, and (*v*) aggregating the weighted utility for each option and selecting the one with maximum utility value.

Prescriptive choice modes

Decision-making under uncertainty consists of two distinguished activities: judgment and choice (Bell et al. 1988). There are historically three major approaches to making choices among decision alternatives: maximizing, incrementalizing, and satisficing. Maximizing refers to maximizing expected utility, which has been used for the normative decision model. Incrementalizing is a descriptive choice model for group decision-making situations by emphasizing agreement among decision-makers who have conflicting preferences and objectives.

Satisficing, initiated by Simon (1955), emphasizes that, although most decision-makers would prefer to maximize their expected utility, it is not possible because they cannot be perfectly informed, sensitive, and rational in the real world. Rather, it suggests that a more realistic and prescriptive choice is a satisfactory course of action that satisfies a certain level of the intended goal or desire of the decision-maker.

Decision modeling tool: multi-attribute decision analysis method (MADAM)

This paper evaluates the reviewed decision theories in terms of their capability to (*i*) enhance decision quality under uncertainty, (*ii*) meet multi-attribute decision requirements, and (*iii*) provide practicality and ease of use. Table 1 summarizes the evaluation results of the decision theories and shows that no single decision model meets all of these criteria.

Based on the analysis, the authors develop MADAM as a relevant theoretical background to formalizing the go/no-go decision situation. MADAM combines the advantages of the DA analytic features in modeling decision procedures under uncertainty with the simplicity of SMART as a multi-attribute decision model and the pragmatic feature of satisficing. This study establishes the minimum acceptable utility score of each decision attribute as an attribute-level satisficing criterion. The minimum utility score of a single attribute is then combined by using an additive function to come up with the overall minimum acceptable utility scores of a project as a project-level satisficing criterion. The following equation signifies the project choice concept of MADAM:

$$[1] \qquad U = \sum_j \sum_k w_j u_{jk} p_{jk} \geq \text{minimum acceptable utility of a project}$$

where U is the total utility score of a project to be considered, w_j is the importance weight for the jth decision attribute, and $u_{jk} p_{jk}$ is the expected utility of the jth attribute reflecting the probabilistic event states (k) of the jth attribute.

Formalizing the go/no-go decision model

The go/no-go decision model consists of two parts, namely a decision process model, and a decision variables relationship model. The decision process model is to provide logically sequential decision processes that offer prescriptive ways to make a quality go/no-go decision under uncertainty. The decision variables relationship model represents the computational features to evaluate project conditions based on the interrelated risk variables and decision attributes and their complex hierarchical structure.

Decision process model

Figure 3 shows the process model developed. It distinguishes the negotiable risk variables from the non-negotiable risk variables in step 1.2. The subsequent steps 3.2 and 4.0 differentiate risk variables from decision attributes. Risk variables are the factors that involve probabilities and stochastically influence other risk variables or decision attributes. The decision attributes are the variables with utility scores on which project viability is estimated.

As indicated in steps 4.0 and 6.0, the model requires decision-makers to establish the minimum acceptable level of each attribute. Rather than choosing a definite no-go when project conditions are not satisfactory, the model recommends decision-makers improve the project conditions by developing strategic alternatives and negotiating collaboratively with consortium partners, public agencies, or lenders as illustrated in steps 8.0–12.0. The figure and table numbers in parentheses in the process model specify the figures and tables that are supposed to be obtained when the model is followed to make the go/no-go decision. They are addressed in detail in the following sections.

Decision variables relationship model

The relationship model is the output from step 1.1 to step 3.2 in the process model. Two-step modeling procedures are implemented to form the model. The first is to distinguish the decision variables and their relationships by using an influence diagram as a knowledge mapping methodology. The second is to transform the identified variables into a more conceptualized hierarchical structure.

Application of influence diagrams

In general, there are two methods available to structure decision problems under uncertainty or risks (ADA Decision Systems 2000): decision trees and influence diagrams. Although decision trees display details of any decision problem in a chronological manner, they are complicated to use in communication. By contrast, influence diagrams provide a compact presentation of a decision problem and thus are appropriate for communicating its structure.

Figure 4 shows the go/no-go decision variables and their relationships portrayed by influence diagrams. Different shapes, generally called nodes, symbolize different elements of decision problems: (*i*) squares denote decisions (decision nodes), (*ii*) circles denote risk variables with probabilities (chance nodes), and (*iii*) rectangles with rounded corners denote outcomes (value nodes). The arrows into value nodes designate the information flows from other value nodes or a decision node. The arrows from a chance node (called “predecessor”) to other chance nodes (called “successor”) or to value nodes indicate probabilistic dependence of the successor on the predecessor, consisting of marginal, conditional, and joint probability dependent on their cause–effect relationships.

A total of 20 decision variables were identified through extensive case studies as good for representing multiple concerns in the selection of a feasible toll road project. Eleven projects that have been being built worldwide were studied, including the LASER and Toulouse projects in France and the E-470 Beltway in the US (Henk 1990), Santa Ana Viaduct Express in California (Gomez-Ibanes and Meyer 1991), Texas 2020 project and Chicago – Kansas City toll way (Gonzalez-Ayala et al. 1993), Chonan–Nonsan highway in Korea (Daewoo Construction Company 2002), and Highway 407 in Canada (Gomez-Ibanes et al. 1991).

Hierarchical configuration of decision variables

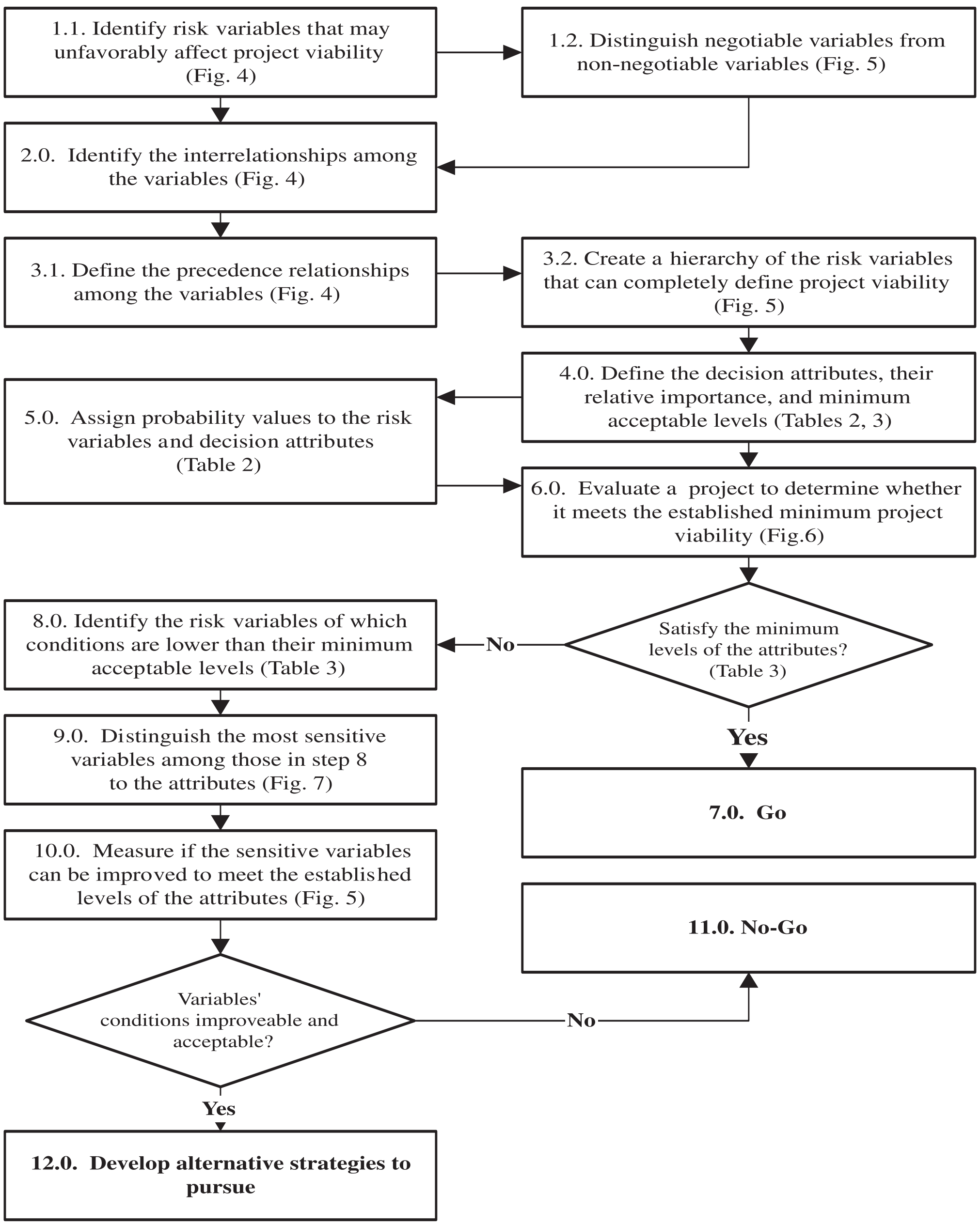
Although the relationships depicted with influence diagrams show the overall decision problem structure at a glance, it does not offer a clear view on which the decision variables and their relative importance can be systematically analyzed. Transferring the relationships into a single-dimensional hierarchy with respect to the variables preceding or succeeding relationships represented by the arrow di-

Table 1. Evaluation results of the decision theories.

Criterion	Decision analysis	MAUT	SMART	Satisficing
Decision under uncertainty	Supported[a]	—	—	—
Multi-objective decision requirements	—	Supported	Supported	—
Practicality in use	—	—	Supported	Supported

[a]Indicates that the criterion marked is explicitly supported by the theory.

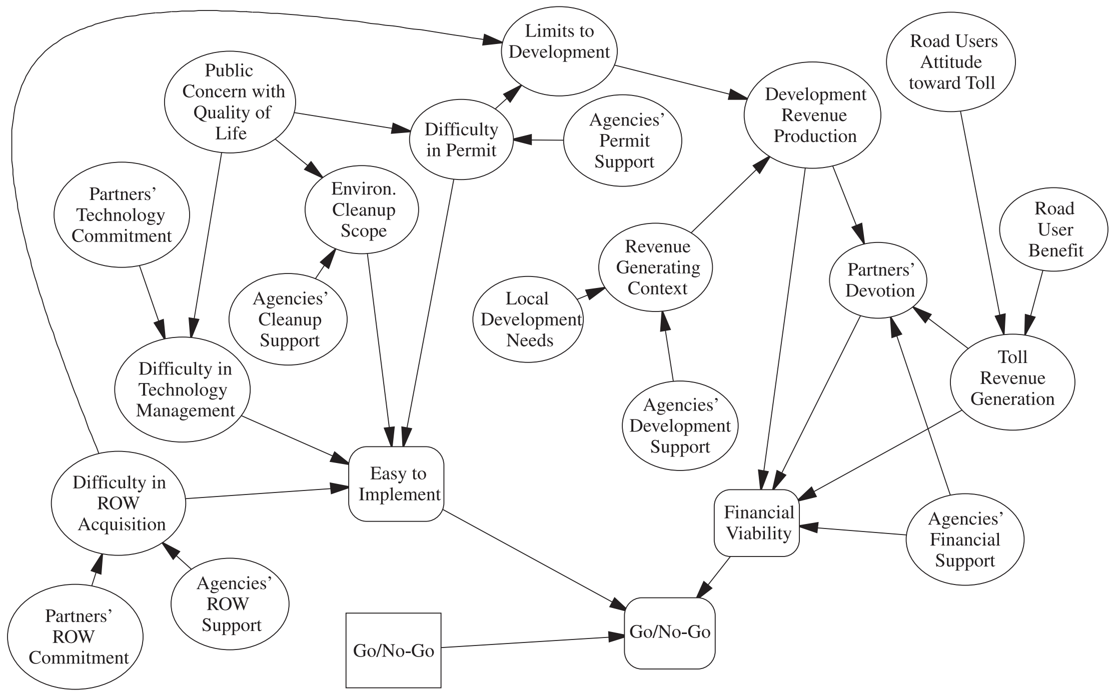
Fig. 3. Go/no-go decision process model.



rections in Fig. 4 is more helpful for decision-makers to understand the complex model (see Fig. 5). The decomposition diagram was used to form the single hierarchical structure of the variables relationships.

Two top-level decision attributes were distinguished among the 20 decision variables which were deterministic in nature (i.e., value nodes in the shape of rectangles with rounded corners in Fig. 4), namely financial viability and easy to implement. These factors are considered the most significant motivation for developers to participate in BOT projects (Gomez-Ibanes et al. 1991). Next, eight probabilistic sublevel decision attributes that affect the top-level attributes were identified (i.e., chance nodes in the shape of circles in Fig. 4): namely toll revenue production, agencies' financial support, development revenue production, and partners' commitment to finance the project under the "fi-

Fig. 4. Influence diagrams of the go/no-go decision variables. ROW, right-of-way.



nancial viability" category and difficulty in right-of-way (ROW) acquisition, difficulty in technology management, environmental cleanup scope, and difficulty in permit under the "easy to implement" category.

While the attribute "agencies' financial support" represents the satisfaction level of the government's financial support or guarantee to a project and "partners' commitment to finance the project" denotes the satisfaction level of financing by the prospective consortium partners or financial lenders, the two attributes "toll revenue production" and "development revenue production" address the economic concerns of a project, which is represented as the following formula:

$$\sum_{t=0}^{n} \frac{\mathrm{CC}_t}{(1+r)^t} = \sum_{t=n+1}^{N} \frac{\mathrm{OR}_t - \mathrm{OC}_t}{(1+r)^t} + \sum_{t=n+1}^{N} \frac{\mathrm{ANR}_t}{(1+r)^t}$$

[2]

$$r = E_{\mathrm{p}}R_{\mathrm{e}} + D_{\mathrm{p}}R_{\mathrm{d}}$$

where n is the construction period, N is the concession period, CC_t is the construction cost in the tth period, OR_t is the toll revenue in the tth period, OC_t is the operating cost of a road in the tth period, ANR_t is the revenue from supplementary developments in the tth period, r is the discount rate, E_{p} is the equity ratio, R_{e} is the nominal required return on equity, D_{p} is the debt ratio, and R_{d} is the nominal cost of capital as to debt.

Except for the attribute "environmental cleanup scope," three other attributes in the category of "easy to implement" represent the degree of ease in meeting the requirement of permit, ROW, and technology. Environmental cleanup scope stands for the amount of environmental cleanup requirements by the public agencies.

Given the model, the project feasibility is evaluated on the 10 decision attributes by using eq. [1]. The 10 risk variables under these attributes influence the conditions of the attributes in the form of marginal, conditional, or joint probabilities in accordance with the arrow directions in the relationship model. The probabilistic settings of each decision variable would be delivered by using two, three, or more verbal expressions, e.g., good–bad or excellent–moderate–bad, depending on the model user's judgment as to their appropriateness to addressing the project conditions signified by the variable. The following section illustrates examples of the verbal settings.

A brief explanation of the risk variables that have not been explained in detail up to this point is provided in Appendix A. The five shadowed circles in Fig. 5 indicate the variables that are negotiable with the government, and the three gray circles are the items that are negotiable with the consortium partners.

Numerical example: computational procedures of the model

Computational procedures of the decision model follow from steps 4.0–12.0 in the process model (Fig. 3). A hypothetical decision problem was prepared to test the procedures: (*i*) developers like to determine a go or no-go for a BOT project with a 100 point scoring system, assigning 70% importance to financial viability and 30% to ease of implementation; (*ii*) developers consider, in the category of "financial viability," the attributes of "toll revenue production" and "development revenue production" as 1.5 times more important than the attributes of "agencies' financial support" and "partners' commitment to finance the project;" (*iii*) developers also allocate an incremental importance weight to the attributes in the category of "ease of implementation" as

Fig. 5. Hierarchical relationships of the decision variables.

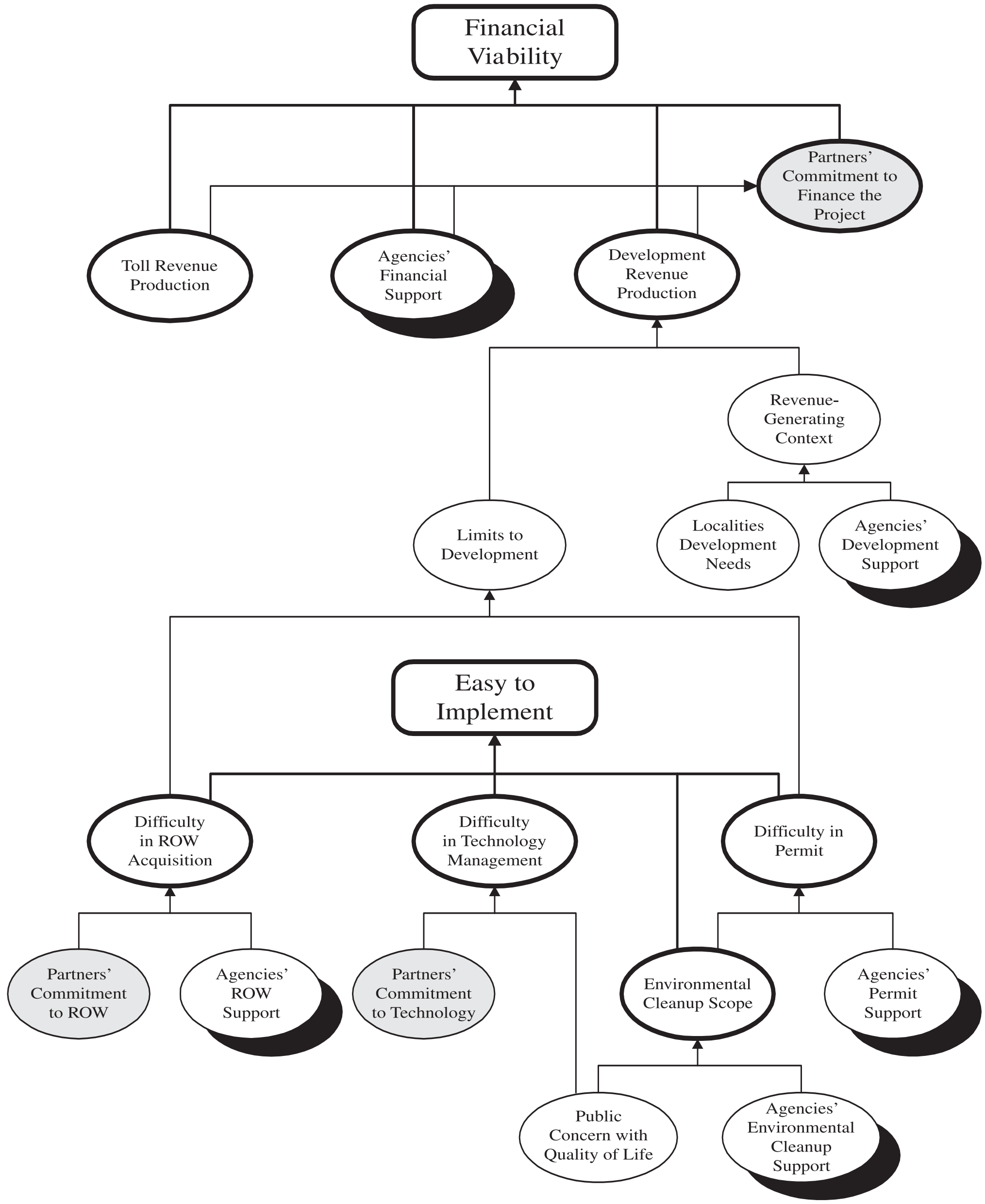


Table 2. Hypothetical project conditions of the numerical example.

Decision attribute	State	Probability	Minimum level
Toll revenue production	Satisfactory, moderate, poor	0.3, 0.6, 0.1	Moderate
Agencies' financial support	Satisfactory, moderate, poor	0.3, 0.6, 0.1	Moderate
Development revenue production	Satisfactory, moderate, poor	0.3, 0.4, 0.3	Moderate
Partners' commitment to finance the project	Satisfactory, moderate, poor	0.2, 0.6, 0.2	Moderate
Difficulty in ROW acquisition	Low, normal, extreme	0.3, 0.3, 0.4	Normal
Difficulty in technology management	Low, normal, extreme	0.2, 0.5, 0.3	Normal
Environmental cleanup scope	Low, normal, extreme	0.2, 0.4, 0.3	Normal
Difficulty in permit	Low, normal, extreme	0.4, 0.4, 0.2	Normal

follows: difficulty in technology management to difficulty in permit to difficulty in ROW acquisition to environmental cleanup scope = 1:2:3:4; (*iv*) Table 2 shows the hypothetical project conditions represented with the probability values of the eight sublevel decision attributes and their presumed minimum acceptable level.

Although this research hypothetically sets up the probabilistic project conditions for testing the analytic features of the decision model, in real decision situations developers need to figure out the probabilities of each decision variable. The tasks can be met by the use of historical project data similar to the one being pursued, developers' experience, or if they are not available, measuring subjective probabilities through expert workshops.

Satisficing limits (step 4.0)

The computational procedures start from step 4.0. There are two importance-weighting methods available, namely the direct rating method and the eigenvalue method, which were employed in the analytic hierarchy process (AHP) (Satty 1980). Although the AHP is explicitly useful in expressing the relative importance of a variable with a pairwise comparison technique, this research assumes, as stated in the hypothetical decision problem, that developers adopt the direct rating method. The go/no-go decision model aims at providing a prescriptive guideline in choosing a feasible project rather than the normative way that should be followed. The direct rating method, which is used in SMART, is more applicable than AHP to this objective.

Table 3 shows the maximum utility of the eight sublevel decision attributes calculated by use of the direct rating method (see column 2). The maximum utility signifies full satisfaction with the project conditions expressed as the decision attributes. In contrast, the numbers in column 3 in Table 3 present the hypothetically assumed minimum satisfaction levels of the attributes, which correspond to the verbally expressed minimum levels in column 4 of Table 2.

Strategic alternatives (steps 6.0–12.0)

To numerically analyze the example case on the basis of the probabilistic conditions in Table 2 and the maximum–minimum acceptable utility of the decision attributes in Table 3, decision programming language (DPL) was used. DPL is commercial software (ADA Decision Systems 2000) that combines the advantages of an influence diagram with the precision of a decision tree. It offers decision-makers tools for structuring decision problems; conducting the deterministic and probabilistic analysis; generating risk profiles, optimal decision policies, and sensitivity analysis; validating the analysis results; and communicating the implications of the overall decision analysis procedures. Figure 6 shows the decision outcome analyzed with DPL.

Also, column 5 in Table 3 indicates the satisfaction levels of the decision attributes corresponding to the probabilistic conditions. Whereas the established minimum acceptable level as the project-level satisficing criterion is 56, the calculated expected utility of the numerical example is 53.4. Based on the comparison of the two values, the decision should be no-go. It is not sufficient, however, for the developers to understand which decision attributes exceed the minimum satisfaction level and which do not. Before strictly determining go or no-go, the satisfaction level of the attributes needs to be examined to measure whether project conditions can be improved.

Four attributes that have a normalized number less than one shown in column 7 in Table 3 do not satisfy the minimum acceptable limit. Given the analysis results, the developers can figure out what project conditions should be specifically improved. By keeping track of the risk variables that influence the unsatisfied attributes, they can also arrange doable strategic alternatives to enhance project viability.

Figure 7 shows the sensitivity analysis results of the example case and enables the developers to comprehend which decision variables have the greatest impact on the decision outcome. The decision attribute with the bar lying at the top of the graph is the most sensitive to the decision outcome, whereas the decision attribute with the bar at the bottom of the graph has little impact. Obviously, among the four unsatisfied attributes, "development revenue production" and "agencies' financial support" should be managed more carefully to improve project viability.

It is necessary to point out that the decision results from the go/no-go decision model can vary by varying the assigned probabilities and weightings to the variables. As stated earlier, the decision model is aimed at providing a prescriptive guideline for the developers to make a better decision to choose a feasible project. Developers can put both different weightings and minimum acceptable criteria to the decision attributes in the relationship model depending on their specific evaluation concerns with a project and probabilities based on their judgment of project conditions.

Model validation

Model validation includes the process of measuring the accuracy of a model in describing the actual conditions of a problem to solve, i.e., internal validation, and in evaluating the usefulness of the model in terms of its objectives to a larger population of similar problem contexts, that is, external validation. As mentioned earlier, a case study methodology was used to validate the model.

Sixty subjects were invited from three different sources in Korea to perform the case studies: seven BOT experts from three multinational construction companies (i.e., Dae-Woo, Hyun-Dai, and Sam-Sung) and eight faculty members and 45 graduate students in the construction engineering and management programs at five universities. Subjects from the companies have worked as program managers to promote diverse international BOT projects for a number of years. The faculty members are regular members of the Privatized Projects Evaluation Boards, MOCT, Korea, where they have evaluated the feasibility of various privatized construction projects programmed by Korean governmental institutions or proposed by multinational private companies.

Although the subjects from graduate schools have not experienced real BOT project evaluation activities, most of them have worked for traditional construction projects and understand the generic procedures and characteristics of BOT projects through graduate course work. For convenience, the subjects from the first two sources are hereafter referred to as the expert group (EG) and those from the last source as the test group (TG).

Case study projects

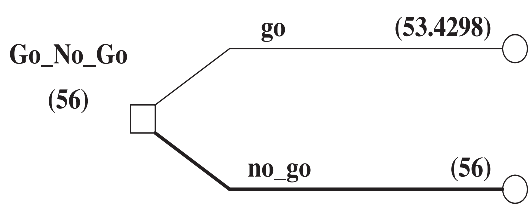
Three case studies, the so-called California, Ontario, and Texas projects, were prepared based on three real BOT projects, the Santa Ana Viaduct Express (SAVE) project in California (Gomez-Ibanes and Meyer 1991), Highway 407 in the Greater Toronto Area (Gomez-Ibanes et al. 1991), and the Texas 2020 project in Texas (Gonzalez-Ayala et al. 1993).

Table 3. Numerical presentation of the decision attributes' satisfaction status.

Attribute	Max. utility[a]	Minimum level Utility[b]	Minimum level % to max.	Calculated project status Utility[c]	Calculated project status % to max.	Normalized rate[d]
Easy to implement category (30%)						
Difficulty in ROW acquisition	9.0	5.0	55.5	5.0	55.5	1.00
Environmental cleanup scope	12.0	6.0	50.0	6.2	51.7	1.03
Difficulty in technology management	3.0	2.0	67.0	1.5	50.0	0.75
Difficulty in permit	6.0	3.0	50.0	2.0	33.0	0.66
Subtotal	30.0	16.0	53.0	14.7	49.0	0.92
Financial viability category (70%)						
Development revenue production	21.0	12.0	57.0	10.0	47.6	0.83
Agencies' financial support	14.0	7.0	50.0	5.6	40.0	0.80
Partners' commitment to finance the project	14.0	7.0	50.0	7.3	52.1	1.04
Toll revenue production	21.0	14.0	67.0	15.4[e]	73.3	1.10
Subtotal	70.0	40.0	57.0	38.7	55.3	0.97
Overall total	100.0	56.0	56.0	53.4	53.4	0.95

[a]Weight applied and maximum utility calculation as follows: 3/(1 + 2 + 3 + 4) = 0.3; 100 × 30% × 0.3 = 9.
[b]The utility indicates the developer's minimum satisfaction level with the project condition represented by the decision attribute in column 1.
[c]From the DPL calculation.
[d]Obtained from dividing the number in column 5 by that in column 3.
[e]An expected utility calculated on both the probabilities in column 3 of Table 2 and the utility values, i.e., 21 for maximum satisfaction level (column 2), 14 for minimum satisfaction level (column 3), and 7 as assumed for poor situation. Expected utility is computed as follows: (0.3)(21) + (0.6)(14) + (0.1)(7) = 15.4. Values less than 1.00 do not satisfy the minimum acceptable limit.

Fig. 6. Decision outcome of the example case (DPL result).



The real project conditions were modified to shape diverse project conditions (e.g., good, moderate, or bad) to measure the model's usefulness in enhancing decision quality regardless of specific project conditions.

The modification includes manipulating project economic situations and project requirements–supports from the public agencies and assigning the critical failure factors of the toll road projects to each case. Price Waterhouse (1993) recognizes nine critical factors that lead to the failure of toll road projects. Table 4 summarizes the detailed conditions of the case projects from these perspectives. Based on the manipulation and prior assessment of each project, the Ontario project was assumed to be a "good" candidate, the California project a "moderate" candidate, and the Texas project a "bad" candidate.

Validation procedures

The overall validation procedures are derived from a convergent validation (CV) methodology that has been widely used to validate a multi-attribute decision model (von Winterfeldt and Edwards 1986). Three processes are involved in the method: defining problems, evaluating the problems on the decision model and on decision-makers' judgment, and measuring a correlation between the two evaluation outcomes. A high correlation between them is expected to occur if the model properly describes the judgmental evaluation preferences.

This study assumes that the decisions of the EG for each project are the decision-makers' judgment and those of the TG are based on the model. The decisions of the TG were compared to those of the EG to measure the degree of correlation. Three-step procedures were implemented. First, the subjects in the EG determined a go or no-go for each case with both their judgment and the go/no-go decision model. Their decision in each case was used as a criterion to examine the decision quality improvement of the TG. The perception of the EG subjects as to the accuracy of the model in delivering the decision problem context was measured.

Second, the subjects in the TG decided a go/no-go for each case with a different decision tool (i.e., the first project with their intuitive judgment and the second project with the model). Cowles (1974) suggests that "approximately 15 subjects for each main group should suffice when the experiment design has several levels of independent variables." The experimentation case design for this research consists of multiple levels of independent variables: different decision tools and project conditions. Accordingly, a minimum of 15 participants for each test group was chosen for a basic sample size. The subjects in the TG were divided into three subgroups, that is, TG-1, TG-2, and TG-3 (15 subjects in each subgroup), and the cases were distributed to each subgroup both in a different order and in 1 week intervals to prevent a reactive effect of test arrangements, which precludes generalization of the model on good or bad project condition, and to exclude multiple treatment interference, which occurs when multiple tests are applied to the same subjects. The last step of the validation process was then to compare the decision results of the TG with those of the EG to measure the decision correlation coefficients.

Fig. 7. Sensitivity analysis results of the decision problem.

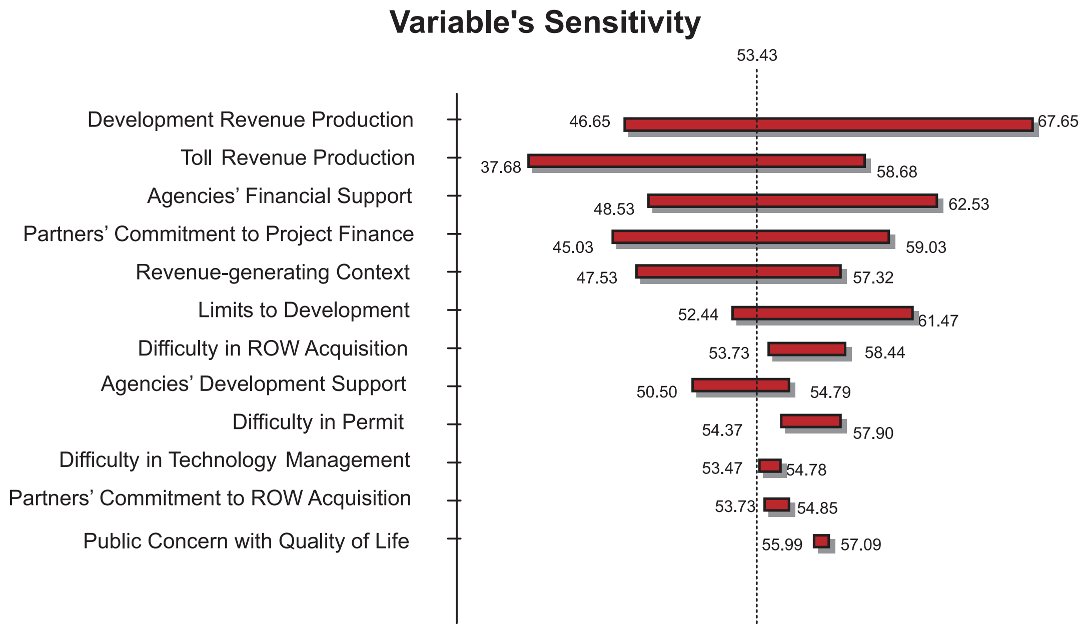


Table 4. Summary of the case projects conditions.

Project conditions	Ontario	California	Texas
Important project conditions of the case projects			
Concession period (years)	30	30	30
Maximum allowable rate of return (%)	20	18	16
Developing supplementary facilities	Allowed	Allowed	No
Leasing state-owned property	Allowed	Allowed	No
Responsibility of ROW acquisition	Developer	Developer	Developer
Agencies' ROW acquisition support	Negotiable	Negotiable	No
Responsibility of permits	Developer	Developer	Developer
Agencies' permit support	Negotiable	Negotiable	Negotiable
Responsibility of environmental cleanup	Developer	Developer	Developer
Agencies' cleanup support	Negotiable	No	No
Break-even point	12th year	12th year	15th year
Federal–state funds available	Available	No	No
Agencies' financial support	Negotiable	Negotiable	No
Equity requirement (%)	20	30	40
Right of initial toll rate setting	Developer	Developer	Developer
Escalating toll rate	Allowed	Allowed	Allowed
Government guarantee	Available	No	No
Assignment of the critical failure factors			
Use of periodic toll rate increase	No	Yes	Yes
Political instability	No	No	No
Competing route existing	No	No	Yes
High rate of revenue growth forecasting for initial 4 years after opening (more than 5%)	No (5%)	Yes (7%)	Yes (9%)
High toll rates application	No	No	No
Optimistic development revenue forecasting	No	No	No
Development road rather than congestion reliever	Partially	No	Partially
Short ramp-up period assumption (less than 5 years)	No (5 years)	Yes (3 years)	Yes (3 years)
Overestimate of the willingness of the road user's toll payment	No	No	No

Validation test results

Internal validation

After determining a go or no-go decision for each case project, the EG was requested to answer the following questions using a seven-point rating scale, where 7 stands for very excellent and 1 for very poor, to measure their perception of the model's appropriateness to represent a go/no-go decision procedure and environment: (*i*) How accurately does the model address information relevant to a go/no-go decision? (*ii*) How well does the model structure the decision problem based on the information, thereby identifying any necessary trade-off? (*iii*) How properly does the model identify the negotiation items on which doable strategic alternatives can be suggested to improve the problem conditions? and (*iv*) How logically does the model guide decision procedures? The questions were developed from a decision quality chain by Matheson (1992), where six items are determined as the significant factors to obtain a quality decision under uncertainty: (*i*) appropriate decision frame, (*ii*) creative and doable options, (*iii*) meaningful and reliable information, (*iv*) clear value and trade-off, (*v*) logically correct reasoning, and (*vi*) commitment to action.

Table 5 summarizes the results of the questions. Although the model was perceived overall as appropriate in demonstrating the decision problem circumstances (average 82%), the subjects from companies held more conservative viewpoints on the model. They expressed that the process model is somewhat theoretical to use, and the relationship model is in general useful to review the factors that should not be ignored in the preliminary evaluation of BOT projects. When deciding a go/no-go for each case project, most of them, however, showed dependency on their judgment or rudimentary economic analysis rather than on the model.

The faculty members rated the model more favorably than the company experts. They described that the relationship model would be useful to educate new-entry developers to a BOT market, and they mentioned that the process model is likely to be a reasonable approach overall under the uncertain project conditions at the up-front project development process.

Several experts pointed out three items that were missed in the model: (*i*) whether revenue is tax exempt, (*ii*) which party is responsible for the force-majeure risk, and (*iii*) political stability. These items were not included in the go/no-go model as decision variables because the authors assumed that they are a matter of yes or no rather than a matter of risk. The first two items have been, in general, described clearly in the RFP from public agencies (Gomez-Ibanes et al. 1991). As to political stability, all projects reviewed during this study emphasized that it is a matter of "must" to be satisfied before promoting a BOT project.

External validation

Table 6 summarizes the decision outcomes of 60 subjects. Although the Ontario project was assumed good to propose and all the EG subjects were expected to decide to go for it, two subjects from the companies chose a no-go. They mentioned that no matter how good revenue conditions of a BOT project would be, they never choose the project if ROW acquisition and environmental cleanup are not completely done by the government because their impact on project schedule and cost would be unpredictable if the tasks go badly.

As opposed to the Ontario project, the Texas project was designed as bad to go and, as expected, none of the EG subjects chose a go. As for the California project, 60% of the EG subjects (9 out of 15, including all subjects from the companies) recognized it as inappropriate to promote. They mentioned that the project included diverse unfavorable and vague conditions to pursue. This implies that the experts from the companies have a more conservative viewpoint to measure project feasibility.

This paper measured the correlation coefficients between the decision results of the EG and those of the TG. Gardiner and Edwards (1975) provided the CV results for the various multi-attribute decision models where one to nine attributes were involved. The correlation rates vary from 0.70 to 0.95 in proportion to the attribute numbers. The researchers translate the finding as supporting the convergent validity of the models, pointing out that the correlation tends to decrease as the number of attributes increases.

Figure 8 shows the go decision rates of the two groups for each case project. Assuming that, on the basis of the decisions of the EG, the right decision of the Ontario project is a go, the California project a no-go, and the Texas project a no-go, Table 7 summarizes the comparison of the decision correlation coefficients. The calculation of the coefficients for each project is obtained from dividing the numbers of the TG right decisions with no tool and with the decision model by those of EG right decisions, respectively. The coefficients of all three projects increased in use of the go/no-go decision model. Given the comparison results and Gardiner and Edwards's criterion, it is inferred that the go/no-go decision model helps the decision-makers enhance their decision quality, regardless of the specific project conditions.

After the case studies, the subjects in the TG were asked what aspects of the model presumably contributed to their decision-making. They pointed out that the relationship model showed a big picture of the decision problem. In addition, they denoted that the process model, through providing a step-by-step decision procedure, improved their overall decision formulation confidence and extended their view of decision-making from simply choosing an action to developing strategic alternatives in the given decision context.

Discussion

During the case studies, two issues were recognized as entailing more research. The first is how to establish the minimum acceptable level of each decision attribute. Since there are few historical BOT projects available and a limited number of developers have been engaged in the projects, it is difficult to investigate dependable references to set up the minimum satisfaction levels of the attributes.

The second issue is similar to the first: how to obtain reliable probabilities of the decision variables. The BOT projects include a variety of uncertain conditions. Estimating subjective probabilities will be an essential task to measure preliminary project feasibility with the go/no-go decision model developed. As more projects are procured in the fu-

Table 5. Experts' perceived accurateness (%) of the decision model.

Subject	Information provision	Decision structure: Structure	Decision structure: Trade-off	Doable options	Decision sequence
Industry experts	75.7	82.1	76.7	67.8	62.5
Faculties	90.4	92.8	88.1	88.1	95.2

Table 6. Go/no-go decision results of the 15 test subjects in the expert (EG) and test (TG) groups.

Subject group	Ontario Go	Ontario No-go	California Go	California No-go	Texas Go	Texas No-go
EG	13 (86%)	2 (14%)	6 (40%)	9 (60%)	0 (0%)	15 (100%)
TG-1						
First decision with judgment	9 (60%)	6 (40%)				
Second decision with model			5 (33%)	10 (67%)		
TG-2						
First decision with judgment					7 (47%)	8 (53%)
Second decision with model	11 (73%)	4 (27%)				
TG-3						
Decision with judgment			11 (73%)	4 (27%)		
Second decision with model					3 (20%)	12 (80%)

Fig. 8. "Go" decision choice rate of the subject groups.

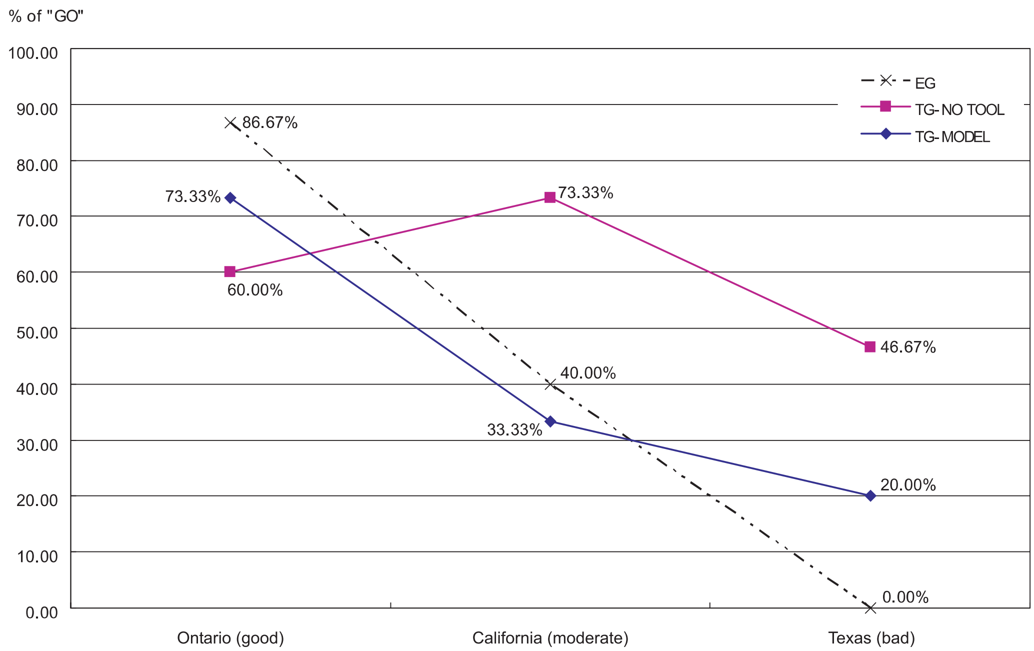


Table 7. Correlation coefficient comparison between the EG and TG decision outcomes.

Decision tool used	Ontario project	California project	Texas project
No tool	0.692	0.445	0.530
Go/no-go model	0.847	0.900	0.800

ture, comprehensive research needs to be conducted to develop effective methods for addressing these two issues.

Conclusions

The research developed the go/no-go decision model, which consists of a process model and a decision variables relationship model. The model is a decision support system that can guide developers to (*i*) recognize the logical step-by-step decision processes to choose a preliminary feasible BOT project to pursue, (*ii*) identify both negotiable and non-negotiable risk variables and decision attributes and their hierarchical interrelationships in the decision-making procedures, and (*iii*) develop the appropriate strategic alternatives that can mitigate the unfavorable impacts of the risk variables on project feasibility.

Being a suitable theoretical background to formalizing the go/no-go decision environment, MADAM was suggested as practical, analytical, and able to effectively meet the multiple objective requirements of the BOT mechanism. It is a combination of the advantages of the DA analytic features in modeling decision procedures under uncertainty with the simplicity of SMART and the pragmatic feature of satisficing. To demonstrate the analytical aspect of the model, a hypothetical go/no-go decision problem was prepared as a numerical example.

A case study methodology was chosen as a proper validation approach to the subjective and judgmental research features. Three BOT highway projects were identified as the case study materials, and 60 test subjects were invited from three different sources to perform the case studies. The overall validation procedures were derived from a CV methodology that is widely used to validate a multi-attribute decision model.

References

ADA Decision Systems. 2000. DPL: decision programming language: advanced version user guide. ADA Decision Systems, Menlo Park, Calif.

Augenblick, M., Custer, B., and Scott, T. 1990. The build, operate, transfer (BOT) approach to infrastructure projects in developing countries. World Bank Working Paper, The World Bank, Washington, D.C.

Bell, D.E., Raiffa, H., and Tversky, A. 1988. Decision making: descriptive, normative, and prescriptive interactions. Cambridge University Press, New York.

Brzozowski, L.J., Turner, L.D., and Olsen, E.E. 1977. Project financing evaluation — a simulation approach. Journal of Bank Research, **7**(5): 40–49.

Call, H.J., and Miller, W.A. 1990. A comparison of approaches and implementations for automating decision analysis. Reliability Engineering and Systems Safety, **30**: 115–162.

Clemen, R.T. 1996. Making hard decisions: an introduction to decision analysis. 2nd ed. Brooks/Cole Publishing Company, Pacific Grove, Calif.

Cowles, M.F. 1974. A rule of thumb for psychology researchers. Perceptual and Motor Skill, **38**: 1135–1138.

Daewoo Construction Company. 2002. A project evaluation report: Chonan–Nonsan highway in Korea. Daewoo Construction Company, Seoul, Korea.

Dias, A., Jr., and Ioannou, P.G. 1996. Company and project evaluation model for privately promoted infrastructure projects. Journal of Construction Engineering and Management, **122**(1): 71–82.

Diekmann, J.E., and Ashley, D.B. 1994. Morrison Knudson public/private partnership project evaluation: a report on the development of the MK P/PP scoring table. University of Colorado at Boulder, Colo.

Gardiner, P.C., and Edwards, W. 1975. Public values: multiattribute-utility measurement for social decision-making. *In* Human judgment and decision processes. *Edited by* M.F. Kaplan and S. Schwartz. Academic Press, New York. pp. 12–23.

Gomez-Ibanes, J.A., and Meyer, J.R. 1991. Private toll roads in the United States: the early experience of Virginia and California. John F. Kennedy School of Government, Harvard University, Cambridge, Mass.

Gomez-Ibanes, J.A., Meyer, J.R., and Luberoff, D.E. 1991. The prospective for privatizing infrastructure: lessons from US roads and solid waste. Journal of Transportation Economics and Policy, **20**(3): 259–277.

Gonzalez-Ayala, S., McCullough, B.F., and Harrison, R. 1993. Preliminary economic evaluation of the highway elements of the Texas 2020 corridor. Southwest Region University Transportation Center, The University of Texas, Austin, Tex. Research Report SWUTC/91/71247-2.

Green, S.D. 1992. A smart methodology for value management. The Chartered Institute of Building, London, U.K.

Henk, G.G. 1990. Implementing the E-470 beltway, major development and transportation projects. *In* Major Development and Transportation Projects: Public–Private Partnerships: Proceeding of the ASCE Specialty Conference, 28–30 June 1990, Boston, Mass. *Edited by* B.K. Lall and D.L. Jones. American Society of Civil Engineers (ASCE), New York. pp. 29–39.

Keeney, R.L., and Raiffa, H. 1993. Decisions with multiple objectives: preference and value tradeoffs. Cambridge University Press, New York.

Kim, J.J., Kim, S.G., and Kim, S.J. 2002. A verification of a feasibility study methodology reflecting the risk for expected return at privately financed construction projects. Journal of Architectural Research, **18**(10): 109–116.

KRIHS. 1998. A study on restructuring private capital inducement system. Korea Research Institute for Human Settlement (KRIHS), Seoul, Korea.

KRIHS. 2002. Introduction of the performance-oriented procurement process for PPI projects. Korea Research Institute for Human Settlement (KRIHS), Seoul, Korea.

Matheson, J.E. 1992. Strategic decision quality. Strategic Decisions Group, Menlo, Calif.

Price Waterhouse. 1993. A guide to public–private partnership in infrastructure: bridging the gap between infrastructure needs and public resources. Price Waterhouse, Washington, D.C.

Public Works Financing. 1998. The international business guide to public/private partnerships and innovative financing. Public Works Financing, New York. Report 72.

Satty, T.L. 1980. The analytical hierarchy process. McGraw-Hill, New York.

Simon, H. 1955. Administrative behavior. 2nd ed. Free Press, New York.

Tiong, R.K. 1995. Competitive advantage of equity in BOT tender. Journal of Construction Engineering and Management, **121**(3): 282–289.

Tiong, R.K. 1996. CSFs in competitive tendering and negotiation model for BOT projects. Journal of Construction Engineering and Management, **122**(3): 205–211.

Tiong, R.K., Yeo, K.T., and McCarthy, S.C. 1992. Critical success factors in winning BOT contracts. Journal of Construction Engineering and Management, **118**(2): 217–228.

von Winterfeldt, D., and Edwards, W. 1986. Decision analysis and behavioral research. Cambridge University Press, New York.

Williams, C.E., and Conrad, S.H. 1996. The return of the private toll road — the Dulles Greenway. Construction Business Review, January/February, pp. 42–46.

Appendix A. Explanation of the risk variables

Localities development needs

Localities development needs represent the approximate needs of supplementary developments such as a parking building or a sports complex. The need is not certain because the public around a project have different interests and expect different benefits from a facility. Developers, however, cannot define exactly their needs but can estimate on the basis of a questionnaire survey or interview at the up-front proposal development process.

Limit to development

Limit to development represents the negative impact of the two risk variables of "difficulty in ROW acquisition" and "difficulty in permit" on the revenue from the supplementary developments. It also cannot be defined clearly at the up-front project development phase.

Revenue generating context

This variable is developed simply to denote invisible positive conditions to the revenue from the supplementary developments.

Partners' commitment to ROW

Developers sometimes hold landowners as an equity partner to easily procure the lands needed, but the possibility of holding them is not certain when preparing a proposal. It should therefore be indicated as probability.

Partners' commitment to technology

Public owners often require developers to provide specific technologies in building a facility. Developers sometimes include the company with the technologies as a consortium partner to satisfy the requirements. The possibility of inviting the company needs to be expressed as a risk.

Public concern with quality of life

Environmental cleanup scope depends on the public around the project. If they are very sensitive to the environmental impact on their quality of life, the extent of environmental cleanup will be increased dramatically.

Agencies' ROW support, agencies' environmental cleanup support, agencies' permit support, and agencies' development support

Public owners often express their intention to support developers in the RFP with sentences like "the public entity can obtain certain portions of the permits required on behalf of developers." The scope of support cannot be clearly defined at the up-front project development phase, however. It can only be estimated on the basis of previous similar projects.