

Evaluating Public-Private Partnership Organizational Alternatives for Existing Toll Roads

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Abstract: Public-private partnership (P3) agreements on existing toll roads in the United States have raised critical questions pertaining to the true costs and benefits associated with these agreements for all stakeholders. Of particular concern is an apparent reliance on monetary calculations alone to determine toll road lump-sum value. This primary focus on monetary considerations appears to neglect a number of nonmonetary variables associated with potential benefits and costs. The objective of this paper is to present a four-step process that uses two analytical methods to assess the benefits, costs, and other impacts associated with P3 organizational alternatives. The first analytical method uses cash-flow diagrams to calculate the net present value (NPV) for each P3 alternative. The second method weighs the relative importance of quantitative and qualitative (nonmonetizable) variables. Four distinct groups of variables form the basis of the two analytical methods: monetary, monetizable, quantitative, and qualitative. The last two groups represent variables that are nonmonetizable. It is these variables that can reflect the much larger stewardship role that government plays in society. The primary user of these analytical methods is identified as the public sector decision maker who has been asked to make recommendations regarding different organizational alternatives for toll road operation. DOI: 10.1061/(ASCE)ME.1943-5479.0000086. © 2012 American Society of Civil Engineers.

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Introduction

Public-private partnership (P3) agreements on existing toll roads in the United States have raised critical questions pertaining to the true costs and benefits associated with these agreements for all stakeholders [Ahmadjian and Magazu 2009; G. Bel and J. Foote, Working Paper, Xarxa de Referència en Economia Aplicada (XREAP), Barcelona; Foote 2008; Mayer 2007; Papajohn et al. 2011; Ramani and Burris 2008; Raphael 2007; Perez and March 2006]. Complicating matters is that the stakeholders need to choose between multiple, often mutually exclusive P3 strategies, each of which may have associated with them a unique set of costs and benefits (Buxbaum and Ortiz 2009). The premise of the four-step process is that the net value of each P3 strategy can only be reliably determined when all of the costs and benefits (both monetary and non-monetary) associated with each of the strategies is understood and systematically evaluated.

This paper presents a four-step decision process that uses two analytical methods to assess the costs, benefits, and other impacts associated with P3 organizational alternatives. The first analytical method uses cash-flow diagrams to calculate the net present value (NPV) for each P3 alternative. The second analytical method

weighs the relative importance of quantitative and qualitative (nonmonetizable) variables. The primary user of these analytical methods is identified as the public sector decision maker who has been asked to make recommendations regarding different organizational alternatives for toll road operation (Federal Highway Administration 2009). Use of the term “organizational alternative” was chosen over other terms such as “governance structure” because it was determined to have a clearer meaning for the intended user. For other users, this or other terms may need to be changed to terms that provide a clear meaning for the intended user of the process. The P3 decision process involves professionals from a number of different disciplines, and those different professionals often use different terminology to mean the same things.

Four-Step Decision Approach

The following four-steps comprise the decision approach, which will be presented using an illustrative example.

1. Identify organizational alternatives
2. Complete analytical method 1 (analysis of monetary and monetizable factors) for each organizational alternative
3. Complete analytical method 2 (analysis of quantitative and qualitative factors) for each decision maker
4. Discuss the method 1 and method 2 results

An overarching aim of the approach is to help improve the public sector decision maker’s understanding of the potential short- and long-term costs and benefits of P3 toll road organizational alternatives and to encourage the consideration and discussion of such implications in the planning and agreement negotiating process. A well-balanced decision approach will consider and weigh the influences of all variables and not just those that can be expressed in monetary terms.

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Illustrative Example

Toll road USA is a fictional existing toll road somewhere in the United States. Assumptions for the fictional toll road were developed using information from Pennsylvania, Chicago, Indiana, and Massachusetts toll roads. For example, assumptions include that the toll authority has \$2.2 billion of existing long-term toll road debt. Tolls have been held at a “nominal” rate by the state legislature. Efforts by the toll road authority to increase tolls as well as efforts by the governor’s office to increase the gas tax have failed repeatedly. Other alternatives are needed and questions concerning the possibility of creating a concession-level public-private partnership have been raised.

Step 1: Identify Organizational Alternatives

Decision makers have identified three organizational alternatives for consideration in the decision process (AECOM Consult Team 2007a, b). Alternative A maintains the existing public organization with no changes. It is the base case. In this alternative, toll increases remain highly politicized and are granted primarily based on the public and political will for such increases. Revenue generated from tolls is assumed to increase by an average value of 0.5% per year to reflect that assumption. The underlying assumption is that a toll increase of approximately 2.5% will be approved only once every five years. Smoothing that value into an annual increase results in an increase of 0.5% per year.

Alternative B is a public public partnership organization. It is a quasi-public organization similar to a water, power, electric, or other utility. In this alternative, public and political will are assumed to have little influence over toll road operations and policy. Toll revenue is assumed to increase yearly, typically by a scheduled amount between 2% and 5%. Toll schedules in existing concession agreements have been indexed to the consumer price index (CPI) or the gross domestic product (GDP). For this example, yearly variation is smoothed. Toll revenue is increased at a constant rate of 2% per year for the entire 50-year period of analysis.

Alternative C is a concession-level public-private partnership organization. In this alternative, the public sector converts its yearly revenue stream and yearly costs into a single lump-sum payment. Once the public-private partnership agreement is implemented, the public sector will no longer collect toll road revenue or be responsible for yearly operating costs, capital costs, debt service, or other expenses. The private sector concessionaire will control toll road operations and all revenue from toll road operations will flow to the concessionaire.

Step 2: Complete Analytical Method 1 (Analysis of Monetary and Monetizable Factors) for Each Organizational Alternative

Two groups of benefit/cost variables form the basis of this method (Collura 1982; Ghandforoush et al. 2003). The first is monetary variables. These are variables that are directly measured in dollars. Examples of monetary variables include toll and nontoll revenue, operating costs, capital costs, debt service, and lump-sum payment. Monetary variables are often the most understood and the easiest for which to gather data. However, the Pennsylvania Turnpike P3 agreement (Gray et al. 2008) showed that the sensitivity with regard to the assumptions needed for monetary analysis can be striking. A 1% change in the assumed yearly increase in traffic demand resulted in a \$7.1 billion increase over the base-case net present value of \$15.4 billion.

The second group is monetizable variables. These are variables that are measured using something other than dollars, but that can be converted into dollars using a conversion factor. Examples of

monetizable variables could include travel time or delay reductions due to the implementation of cashless payment systems or the cost of traffic diversion to other roadways as a result of toll increases. The assumptions required to assign a per-unit dollar conversion factor to an individual variable must meet or exceed a user-assigned level of confidence in the monetary result. If the assumptions do not meet the required threshold, the variable is not included in method 1, but will be included as a quantitative variable in analytical method 2.

Method 1 uses cash-flow diagrams (Bruun 2007) to combine cost/benefit analysis with net present value analysis. These cash-flow diagrams visually show the contributions of each variable and allow the decision maker to consider the relative importance of all monetary and monetizable factors during the decision process. They add depth beyond simple lump-sum factors, and transparency in that the relative importance of variables can be seen. The visual nature of the cash-flow diagram should increase understanding of the influence individual variables have on the calculation of net present value. This visual nature is in contrast to standard calculations of net present value that result in a single number for comparison.

Cash-flow diagrams have been developed for each of the three organizational alternatives identified in step 1 (see Figs. 1–3). Each cash-flow diagram is calculated for a 50-year period and includes the assumptions made for that cash-flow diagram.

Step 3: Complete Method 2 (Analysis of Quantitative and Qualitative Factors) for Each Decision Maker

Method 2 is designed to create discussion among decision makers regarding the potential influence that quantitative and qualitative variables will have on the decision process. These are the perceptions or beliefs of the decision maker, which cannot be represented in the cash-flow diagram. The method identifies the perceptions of decision makers in order to create a clear basis for discussion with regard to the influence those perceptions are having on the decision process.

Two groups of benefit/cost variables form the basis of this method (Collura 1982; Ghandforoush et al. 2003). The first group is quantitative variables. These are the variables that can be measured, but did not meet the threshold required for inclusion as a monetizable variable. In method 2, these excluded variables are considered a second time, without the need for assignment of a dollar value. Examples of quantitative variables include customer service, traffic diversion, and travel time reliability.

The second group is qualitative variables. These are variables that cannot be measured. Two examples of qualitative variables are the importance of providing toll road access to low-income users and the level of importance associated with the government running toll road operations.

Method 2 asks decision makers to respond to key qualitative statements in two ways and then uses those responses to gauge perceptions with regard to organizational alternatives (Ewing and Baker 2009). It should be noted that development of qualitative statements proved to be quite difficult. It required finding statements to which decision makers’ answers would clearly capture their perceptions or beliefs. Many questions were tried and rejected. Most proved too ambiguous or vague, particularly when applied across different stakeholders. Three statements were finally found that worked well for the illustrative example in that they were clear, concise, and captured the essence of many of the questions or statements that were eliminated as ambiguous or vague. It is anticipated that additional statements will be needed to reflect the requirements

ALTERNATIVE A: PUBLIC ORGANIZATION (BASE CASE)

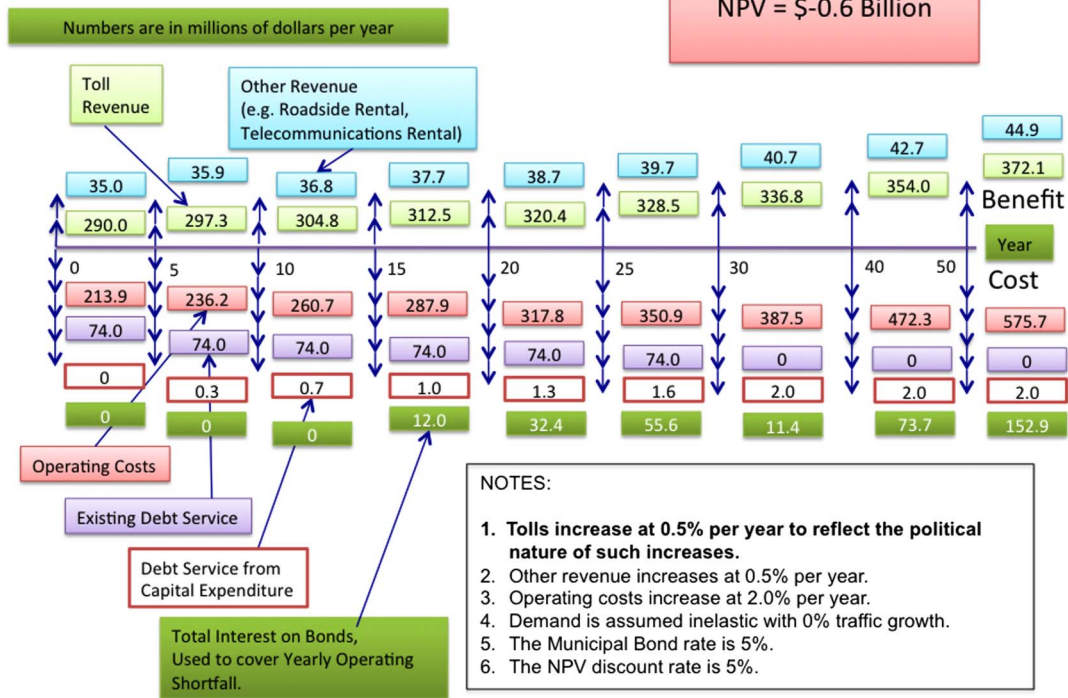


Fig. 1. Cash-flow diagram for alternative A: public organization

ALTERNATIVE B: PUBLIC-PUBLIC PARTNERSHIP ORGANIZATION

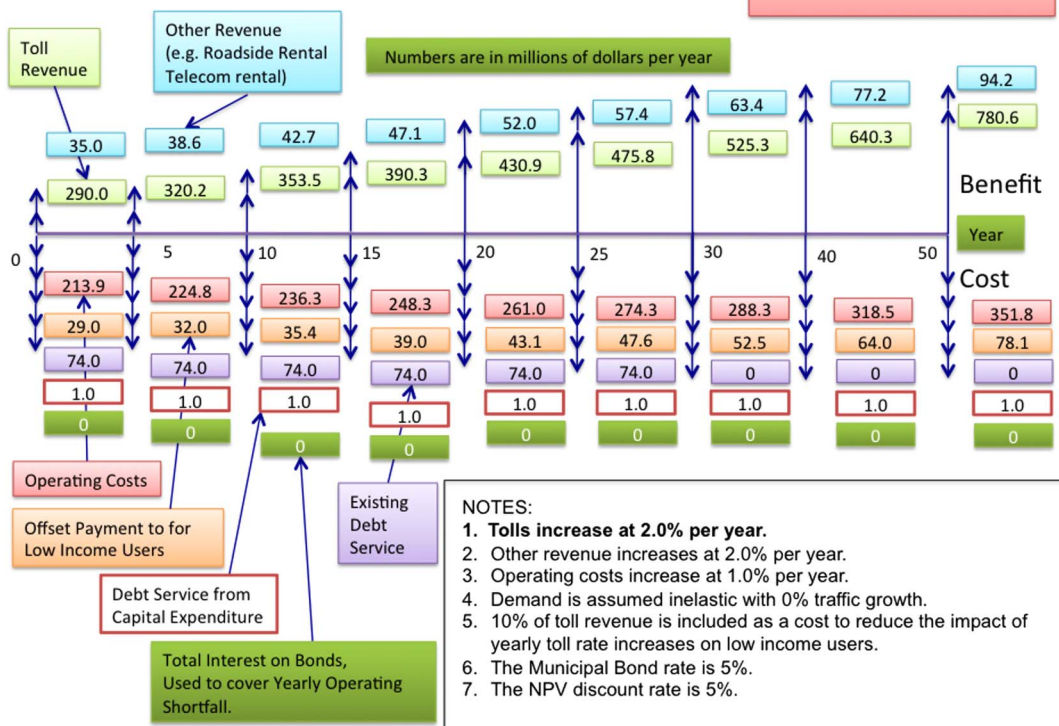


Fig. 2. Cash-flow diagram for alternative B: public-public partnership organization

ALTERNATIVE C:
PUBLIC-PRIVATE PARTNERSHIP ORGANIZATION
(CONCESSION AGREEMENT)

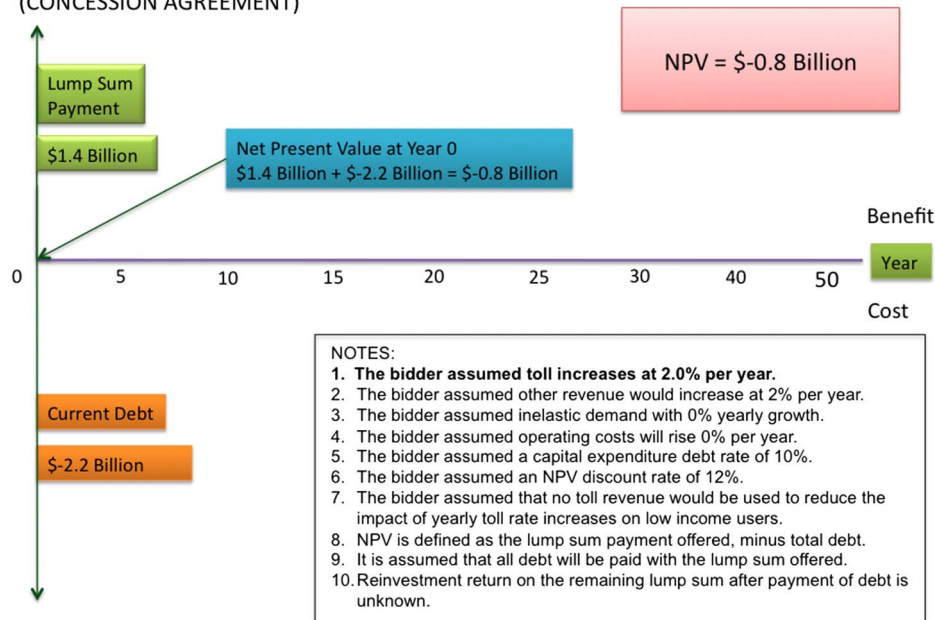


Fig. 3. Cash-flow diagram for alternative C: public-private partnership organization

and conditions of specific projects or processes (Clemen and Reilly 2001; Feng and Robin 2006; Keeney 1992; Keeney and Raiffa 1993). The three qualitative statements developed are as follows:

- Statement 1: A major tax, increase for transportation, such as a gas tax, sales tax, or income tax, should be deferred. Agreeing with this statement is assumed to reflect a perceived level of importance that funds needed to finance transportation infrastructure should be raised and spent by the government. Disagreeing with this statement reflects a perception that funds other than government funds should be used to finance transportation infrastructure.
- Statement 2: A public agency should operate the toll road, rather than a private, for-profit company. Agreeing with this statement is assumed to reflect a belief that removing the toll road from government operation will weaken the government's ability to create or influence policies that are in the best interests of society. Disagreeing with this statement is assumed to reflect a belief that replacing public operations with private sector operations is the only way to increase efficiency, reduce costs, and maximize organizational efficiency.
- Statement 3: Tolls should continue to be charged at some nominal rate (0.5% annually) rather than increasing annually, typically at a rate of 2% to 5% depending on inflation. Agreeing with this statement is assumed to reflect a belief that yearly toll increases have the potential to lower user equity for lower-income users. Disagreeing with the statement is assumed to reflect a belief that increasing tolls annually has the potential to maximize the value of the toll road asset.

A survey was created that asks decision makers to respond to each statement in two ways. First, the decision maker is asked to respond "do not agree," "no opinion," or "agree" for each of the statements. There are 27 possible sets of responses to the set of three statements. The possible response sets include all answer combinations between response set "do not agree, do not agree, do not agree" and response set "agree, agree, agree." Each of the response sets gives some indication of the quantitative and qualitative perceptions of the decision makers.

For example, a response set of "do not agree, do not agree, do not agree" indicates a strong perception that the organization should be operated by a public sector entity. A response set of "agree, agree, agree" indicates a strong perception that the organization should be operated as a public-private partnership.

Second, the decision maker is asked to weight the relative importance of each statement in relation to the others by dividing 100 points among the three statements. To analyze the resulting point distribution, a weighting method was developed. The points assigned to each statement are multiplied by the difference between the actual response given for that statement and the expected response associated with the no change or base case. The results for each statement are summed, assigned the absolute value, and divided by 2. The resulting weight represents the distance from the expected response for the base case to the actual response given and is used to identify potential disconnects between the response set and the assignment of points for the weighting process. Such disconnects can help identify conflicts between monetary and monetizable results and the nonmonetary perspectives of the decision maker.

The weighting method is governed by the equation

$$W_{(E(A)-R)} = \left(\left| \sum_{x=1}^3 (E(A_x) - R_x) \times P_x \right| \right) \div 2 \quad (1)$$

where $W_{(E(A)-R)}$ = the weight (W) representing the distance from the expected response set for alternative A to the measured response set (R), x = the statement number, R_x = the response measured for statement x , $E(A_x)$ = the expected answer to statement x for alternative A , and P_x = the number of points (P) assigned to question x .

To demonstrate method 2, a fictional public sector decision maker was created. The decision maker is the chief financial officer (CFO) of the Turnpike Authority and has the following biography and objectives

- The CFO's objectives are short-term in that the CFO is interested only in the problems that exist today and the focus is financial.

- The CFO is an accountant by trade.
 - The CFO was hired by the current Secretary of Transportation to study the current dire cash flow crisis and to then offer solutions.
- The CFO was asked to complete the method 2 survey (see Fig. 4) and gave the following responses to statements 1, 2, and 3: agree, agree, and agree. The points the CFO assigned to each statement were 20, 40, respectively and 40. The weight associated with that response set and point assignment was then calculated as

$$W_{(E(A)-R1)} = [(1-3) * 20] + [(1-3) * 40] + [(1-3) * 40] \div 2 = 100 \quad (2)$$

$$W_{(E(A)-R1)} = 100 \quad (3)$$

A weighting of 100 is known to be strongly associated with alternative C. A weighting of 50 is strongly associated with alternative B. A weighting of 0 is known to be strongly associated with alternative A. The CFO's calculated weight indicates a strong perception or belief in alternative C.

Step 4: Discuss the Method 1 and Method 2 Results

Alternative A results in an NPV of $-\$0.6$ billion. Lower costs and increases in other revenues could help reduce this negative NPV; however, without higher toll revenue, it is unlikely that alternative A can generate a positive NPV. If this alternative is pursued, other funds will likely be required to cover anticipated shortfalls.

With an NPV of $\$1.9$ billion, alternative B has the only positive NPV of the three alternatives and from a monetary and monetizable

perspective seems to provide the best balance of the three alternatives. Alternative B increases toll revenues and other revenue at the same rate as the private concessionaire in alternative C. Alternative B has 1% lower operating costs, which reflect an assumed higher operational productivity than that of the organization in alternative A. Alternative B assumes a 5% discount rate, which is considerably lower than the 12% rate assumed for alternative C and reflects the public, nonprofit nature of the public-public organization. Finally, alternative B is the only alternative that applies 10% of toll revenue as an offset payment for low-income users.

Alternative C results in an NPV of -0.6 billion and appears to be only somewhat more appealing than alternative A. However, that calculation of NPV assumes that the lump-sum payment will be used to eliminate all existing toll road debt. If that assumption is removed, then alternative C will result in $\$1.4$ billion of immediate cash flow. Alternative C is the only alternative that delivers the full NPV amount as a lump-sum payment in year 0. In the long run, other funding sources would need to be found to cover remaining toll road debt; however, in the short run, that lump-sum payment could be used to cover immediate cash flow needs, without increasing taxes.

Method 2 showed the fictional decision maker had perceptions or beliefs that leaned strongly toward alternative C. In addition, the stated objectives of the decision maker were to find a solution to the current cash flow crisis. Given that objective and the method 2 result, alternative C may be the option favored by this decision maker.

The 4-step decision process presented is designed to create discussion about such potential decisions. The process creates additional information, beyond simply that of a monetary nature, which can then be used to initiate such discussion among stakeholders or the general public with regard to the full benefits and costs of the P3 alternatives proposed. Such discussion has the potential to provide increased transparency for the general public and other stakeholders.

Summary and Recommendations

Unlike previous analyses, which used financial methods to determine the lump-sum payment offered and little else, the 4-step decision approach proposed employs a broader analysis framework, including monetary, monetizable, and nonmonetizable costs and benefits, which are more familiar to the transportation field and have historically given a more complete picture of the decision to be made. The two methods are not complex and much effort was made toward making them simple to use. Development efforts showed that increasing complexity did not necessarily increase accuracy or usefulness, particularly for the nonmonetizable variables.

The two analytical methods presented in this paper are a first step. However, more research is needed before a fully functional set of analytical methods can be developed. The following are two areas of potential research interest and benefit. First, research is needed to determine which variables can be measured and monetized using reasonable assumptions and which cannot be assigned monetary value, even though they are measurable. Second, research is needed to define the usage of certain terminology and concepts, which vary from stakeholder to stakeholder. Attempts to clearly define these terms and concepts and then include them in the analytical methods often resulted in frustration. Examples of terms include value, effectiveness, efficiency, customer service, risk, iterative, and nominal. Examples of concepts includes impacts on highway safety when a private corporation operates the toll road, impacts on traffic delay if traffic demand is not assumed inelastic, fundamentals behind the role of government, the challenges

Non-Monetizable Factor Method Survey		
Chief Financial Officer		
Instructions:		
1. Please respond to the following statements by circling the appropriate number.		
2. Then determine the relative importance of each statement. (by distributing 100 points amongst the 3 questions)		
1		Points 20
A major tax increase for transportation, such as a gas tax, sales tax, or income tax should be deferred.		
Do Not Agree 1	No Opinion 2	Agree 3
2		Points 40
A private, for-profit company should operate the toll road, rather than a public agency.		
Do Not Agree 1	No Opinion 2	Agree 3
3		Points 40
Tolls should increase annually, typically at a rate of 2% to 5% depending on inflation, rather than continuing to be charged at some nominal rate (1/2% annually).		
Do Not Agree 1	No Opinion 2	Agree 3

Fig. 4. Method 2 survey for the chief financial officer

associated with measuring user-specific costs and benefits, and the role of equity among users (Cheung and Chan 2011; Howard 2004).

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