Issues Related to the Assessment of Performance-Based Road Maintenance Contracts

Juan C. Piñero*, and Jesus M. de la Garza **, A. M. ASCE

*Graduate Research Assistant, Charles E. Via, Jr. Department of Civil and Environmental Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0105, rpinero@vt.edu
** Vecellio Professor of Construction Engineering and Management, Charles E. Via, Jr. Department of Civil and Environmental Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0105, chema@vt.edu

Abstract

In the late 1980’s and early 1990’s few transportation agencies around the world considered privatization as an alternative to improve the efficiency of the services provided to the public. As a result of this initiative, new partnerships between the public and private sector for maintaining and preserving public roadways were developed and implemented. These new contracting relationships are better known as Performance-Based Road Maintenance Contracts (PBRMC). PBRMC calls for performance-based work, in which a desired outcome is specified rather than a material or method. This contracting scheme promises to be an excellent tool to improve government efficiency in maintaining transportation networks; however, without proper analysis, this type of contract could likely yield adverse outcomes. Since PBRMC are relatively new, the availability of reliable and comprehensive sets of guidelines to evaluate the effectiveness and efficiency of this type of contract is limited. Transportation agencies currently rely on criteria and procedures they have had developed from their traditional methods used to evaluate performance. Unfortunately, some of these procedures cannot appropriately assess the benefits, if any, accrued by the government as a result of engaging a private contractor to perform outcome-based road maintenance activities. This paper presents a general overview of a framework for monitoring PBRMC more comprehensively and accurately. The framework considers the assessment of five main areas -- level of service effectiveness, cost-efficiency, timeliness of response, safety procedures, and quality of services -- in order to guarantee the comprehensiveness and reliability of the evaluation process. The major contribution of this framework is to provide transportation agencies with guidelines for evaluating the effectiveness and efficiency of PBRMC as an alternative delivery method to maintain and preserve the roadway system.

Keywords

Road Maintenance, Performance Measures, Performance Monitoring, Cost-Efficiency, Level of Service, Timeliness of Response, Safety Procedures, Quality of Services
Introduction

It is common for transportation agencies to specify in their road maintenance contracts how the work is going to be performed, the means and methods that are going to be used, and the sequence of the job to be done. According to some road administrators, this traditional contracting approach had failed to meet the main goal of reducing maintenance expenditures and improving the services to the traveling public [Poster 2001]. In the late 1980’s and early 1990’s this philosophy started to change when few transportation agencies around the world implemented new partnerships between the public and private sector for maintaining and preserving public roadways, better known as Performance-Based Road Maintenance Contracts (PBRMC) [Giglio and Ankner 1998]. PBRMC calls for performance-based work, in which the focus is on the final product and not on how it is achieved. The theory behind this contracting scheme is based on the following two facts: (1) that “industry” might know cheaper and better processes, so the government should specify only the desired result or outcome (what) and let the competing offerors choose the processes (how to), and (2) that contractors can work more efficiently when they have maximum freedom to choose the manner in which they will perform the contract [Finley 1989, Tomanelli 2003]. Since PBRMC are relatively new, the availability of reliable and comprehensive sets of guidelines to evaluate the effectiveness and efficiency of this type of contract is limited. This paper presents a general description of a framework that was developed to address this need. The proposed framework provides transportation agencies with a more reliable and comprehensive methodology that can be used to assess the benefits, if any, accrued by the government as a result of engaging a private contractor to perform outcome-based road maintenance activities.

Current PBRMC around the World

There are a few number of performance-based road maintenance contracts currently issued around the world. In the United States, transportation agencies within Virginia (1996), Florida (1998), Texas (1999), and District of Columbia (2000) were the first ones to implement performance based contracts for the maintenance of public roadways. In the international arena, countries such as Argentina (1990), Uruguay (1995), Australia (1996), New Zealand (1998), Brazil, Chile, and Colombia are considered the pioneers on the implementation of this contracting scheme as part of their strategies to preserve the roadway system [Baker 1999, Frost 2001, Zietlow 2001]. Most of the current PBRMC are fixed-price contracts and have a duration between 4 and 10 years. Significant benefits have been claimed by all implementing agencies [Frost and Lithgow 1996, Frost 2001, Hardy 2002, VDOT 2000]. However, we should be concerned on how reliable those benefits are and how comprehensive were the methodologies used to assess those benefits? Limitations in some of these procedures truly affected the reliability and validity of the final assessment. Therefore, there is a need to provide guidelines to transportation agencies on how to
accurately and comprehensively assess the benefits accrued as a result of the implementation of PBRMC.

Framework Components

The framework presented in this paper was basically developed in two stages: (1) an extensive review of the literature relevant to the research topic, and (2) the definition of the main structure of the framework. The first stage, literature review, served as a platform to suggest ideas on the structure of the framework as well as to identify the concepts, criteria, and measures that should be considered when monitoring performance-based work. Among the most important areas reviewed were concepts relevant to performance monitoring, such as: asset management, quality control and assurance (QA/QC) in data collection, sampling statistics techniques, cost estimating and cost analysis, condition assessment of major elements in the roadway system, safety standards related to roadway maintenance activities, and life-cycle analysis. In addition, a review of existing approaches commonly used in the public and private sector for measuring and monitoring performance such as the ISO 9001:2000 Criteria for Performance Excellence, the Malcolm Baldrige National Quality Program, the Kaplan and Norton’s Balance Scorecard Approach, the Department of Energy Performance Measurement Program, and the NCHRP 14-12 Program for Quality Assurance in Highway Maintenance were also reviewed and carefully studied.

Based on the comprehensive review performed, five main components that define the proposed framework for monitoring PBRMC were identified. The five components are: **Level of Service Effectiveness (LOS)**, **Cost-Efficiency (CE)**, **Timeliness of Response (TOR)**, **Safety Procedures (SP)**, and **Quality of Service Provided: Agency and Users Satisfaction (QOS)**. A graphical representation of these components is presented in Figure 1.

![Figure 1. Key Components of the Proposed Framework to Monitor PBRMC.](image)

For each of the five components of the framework a specific structure that identifies the elements to be considered in the monitoring process was defined. The elements within each structure were organized in four (4) sections: **Input, Data Collection, Data Analysis, and Reporting**. The **Input** section identifies critical information to be defined by transportation agencies before implementing this type of contract. In the
second section, **Data Collection**, relevant areas to be considered in the data collection process are identified. This section provides guidance with respect to the identification of data sources to support the monitoring program, the use of information technology as a support to the data collection effort, the use of efficient sampling mechanisms, and the implementation of a proper QA/QC program, among others. The **Data Analysis** section provides specific methodologies to convert the raw data obtained from the data collection effort into meaningful information regarding the actual performance of the private contractor. Finally, effective reporting mechanisms that will help transportation agencies communicate the results from the performance evaluation to all the parties involved in the process and also the traveling public was identified in the **Reporting** section. A general and short description of the aspects included within each one of the framework components is presented in the following sections of this paper. For a more detailed discussion of the proposed methodologies included within each component structure the reader can refer to Piñero and de la Garza 2003.

**Level of Service Effectiveness**

According to Poister 1983, the evaluation of level of service effectiveness is considered one of the most important performance indicators to be incorporated in a monitoring system. The purpose of this evaluation is to indicate the extent to which each asset item maintained by the private contractor has been preserved at a minimum acceptable quality levels specified by the implementing agency in the contractual agreement. The proposed methodology to evaluate this component of the framework provides guidance on aspects such as the creation and update of an asset inventory, the development of a data collection plan and sample selection process, the implementation of a quality control and assurance program (QA/QC), the conversion of raw data into performance information, and the implementation of reporting techniques to help communicate the findings to the interested parties. This research adopted some of the guidelines presented by Stivers et al., 1997 in their report on Quality Assurance in Highway Maintenance Programs to evaluate some of the aspects related to this component, such as the calculation of the LOS ratings. The methodologies proposed as part of this component has been defined is such a way that will help transportation agencies to identify areas of concern such as asset items that have been in continuous deterioration, the re-adjustment of unrealistic performance targets, and the evaluation and comparison of the long-term effectiveness of maintenance treatments normally used by the contractor on their corresponding portions of road with those used by the implementing agency.

**Cost-Efficiency**

The main objective of this component is to assess the cost savings, if any, accrued by the government as a result of engaging the service of the private contractor to perform highway maintenance activities. The methodology adopted to evaluate this component can be summarized in two steps: (1) a comparison of the price of the work done by the private contractor with the price of the work if it is contracted out or self-
performed by the implementing agency, and (2) the evaluation of the impact in the level of service (condition of the roadway system) if the implementing agency spent on maintenance at least at the same rate as the contractor does. A combination of cost estimating techniques and probability analysis has been incorporated in the structure of this component in order to meet the objective. In order to conduct the first step of the study, two different approaches are recommended in the framework: the distribution and the regression approach. By using either distributions or regressions to characterize the behavior of the bid items, the framework proposed the usage of the Monte Carlo Simulation approach to obtain a distribution that represents what would have been the total maintenance cost if the agency assumes the role of the private contractor. It is suggested that transportation agencies conduct the analysis by applying both approaches and then use the results obtained on each one of them to conduct the study proposed in step two, the comparison of LOS versus the expenditures. The Bayes Theorem (probability analysis) has been adopted in the framework to establish the relationship between cost and performance. By considering this technique, it allows road administrators to analyze the impact in LOS by varying the rate in maintenance expenditures. The findings from this study will serve as the basis to finally determine the cost-efficiency of the PBRMC.

**Timeliness of Response**

Evaluating the timeliness of response of the private contractor to service requests related to events or deficient elements in the roadway is extremely important because if the contractor does not respond in a promptly manner then the safety of the traveling public can be placed in serious risk. For this reason, a component that evaluates the timeliness of response (TOR) of the private contractor performing outcome-based highway maintenance activities was included in the framework. In order to conduct a proper evaluation of the contractor’s response, road administrators must define measures that establish acceptable response times by asset type and/or service categories. Timeliness requirements can be specified for services such as: response to incidents, lane closures, response to complaints, response to emergencies, and snow removal, among others. These requirements will serve as the basis to evaluate if the actual response times from the contractor are acceptable or not. The actual performance of the contractor to these requirements should be evaluated by conducting at least the following: (a) a comparison of the actual response times versus timeliness requirements, and (b) a response evaluation of contractor’s performance to unexpected events (e.g., storms, and floods). Moreover, if a comparison of the actual compliance of the private contractor to timeliness requirements versus its performance in this area in previous years is conducted, road administrators will have the opportunity to assess the continuous commitment of the private contractor in keeping a safer roadway system for the traveling public.

**Safety Procedures**

Highway safety is often stated to be the most important goal by transportation agencies. For this reason, it is required to continuously monitor and evaluate the
safety procedures implemented by personnel conducting highway related works, which is the objective of considering this component as part of the framework. In order to comprehensively assess the compliance of the private contractor to safety requirements, it is proposed in the framework to consider the feedback from the personnel that is directly involved with the contractor in conducting regular maintenance activities and also responding to service requests, such as emergencies, road kill removal, traffic control, accidents, and snow removal operations; which normally required the implementation of safety procedures. Among the personnel that are normally in direct contact with the contractor when conducting these activities are Police Departments, Emergency Response Units, Sub-Contractors, and DOT Safety Coordinators. These individuals are considered as excellent sources of information to evaluate the contractor’s safety program. These evaluations can be conducted through the use of surveys. The framework emphasize that the focus in those surveys must be in the evaluation of the following five areas: (1) the involvement of managers in the development and enforcement of a safety program, (2) the implementation of a training program that increase the safety knowledge and safety skills, (3) the implementation of safety related standards, (4) the documentation of incident records and safety inspections, and (5) the innovation in the means and methods. The evaluations of the five areas from all these parties will provide transportation agencies with an overall assessment of the contractor’s commitment to safety.

Quality of Services: Customer, Users, and Employee Satisfaction

Understanding of the traveling public (user) needs is essential for the success of any transportation program. They are the final evaluators of the services provided and even more important they are service payers. For this reason, is very important that transportation agencies assess the customer (agency), users (traveling public), and sub-contractors (employee) perceptions and satisfaction with respect to the condition of the assets and contractor performance. By considering their input, it will allow to define performance measures that will finally guarantee their satisfaction. The methodology that is proposed in the framework to assess the quality of the services in PBRMC consist on interviewing individuals (using surveys) that have been working hand-in-hand with the contractor as well as the ones that have been impacted by the contractor’s work. Among the personnel identified as valuable sources of information are the traveling public, emergency response units, sub-contractors, and DOT contract administrators and supervisors. The surveys to each one of these sources will address different issues or areas of concern, which are: (1) Traveling Public Survey - examine the perspective of the users with respect to the condition of the roadways maintained by the private contractor, (2) Emergency and Highway Patrol Units Survey - examine the overall satisfaction from the emergency and highway patrol personnel with respect to the job the private contractor is performing in maintaining portions of the roadway system, such as: the timeliness of response to emergencies, and the implementation of strategic plan to address emergency events, (3) Sub-Contractors Survey - examine the opinion of the sub-contractors that have performed work for the main contactor with respect to the fairness of the procurement
process used to adjudicate contracts to perform maintenance works as well as the sub-
contractors experiences on how the contractor administers the contracts, (4) *Road
Administrators Survey* - examine the satisfaction of road administrators with respect
to the general performance of the private contractor. The findings from these surveys
must be compared with the findings from the other components of the framework in
order to verify if the perception from the traveling public is in accordance to the
reported condition by the agency.

**Implementation of the Proposed Framework**

The framework presented in this paper was partially applied to the current
performance-based road maintenance contract between the Virginia Department of
Transportation (VDOT) and a private contractor. This contract started in 1996 and it
is considered the first PBRMC in the United States [VDOT 2000]. As of the writing
of this paper, three out of the five components of the framework were applied to this
PBRMC as part of the effort to assess the performance of the private contractor in
maintaining portions of the highway system in the Commonwealth of Virginia. The
three components that have been applied are: the level of service effectiveness, the
cost-efficiency, and the timeliness of response. In comparison to previous years,
significant improvements were achieved by implementing the methodologies
recommended in the framework to evaluate each of these components. Among the
most significant improvements are: an increase in the confidence level at which the
findings from the sampled population were generalized to the whole population
(increase the reliability of the final results), a reduction in the number of sites
required for inspection in order to meet statistical sufficiency for each asset type
(makes the process cost-effective), a more comprehensive assessment of the long-
term benefits accrued by the government, and a significant improvement in
communicating the results to the parties involved by implementing the techniques
described in the reporting sections.

**Concluding Remarks**

The interest on implementing Performance-Based Road Maintenance Contracts
(PBRMC) is increasing from road administrators worldwide. However, they all agree
on the fact that assessing the benefits accrued as a result of implementing this
contracting scheme for maintaining the roadway system is a very complex and
challenging task. In order to help transportation agencies with this challenge, this
paper presented a general description of a framework that was developed to provide
them with guidelines to conduct a comprehensive and reliable evaluation of the
effectiveness and efficiency of PBRMC. It is envisioned that the proposed
framework will provide road administrators with a valuable tool to properly assess the
benefits, if any, accrued as a result of implementing PBRMC as an alternative
contracting mechanism to maintain and preserve the roadway system.
Acknowledgements

The research work described in this paper has been funded by the Virginia Department of Transportation (VDOT). The opinions and findings are those of the authors and do not necessarily represent the views of VDOT.

References