An Evaluation of Current Practices of Road Maintenance Contracting Methods

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ABSTRACT

Departments of Transportation (DOTs) in the United States maintain their roads either by using In-House workers or by Out-Sourcing the works to private contractors. Out-Sourcing uses two types of road maintenance contracting methods, Prescriptive or Method-Based Contracting (MBC) and Performance-Based Contracting (PBC). This study conducted a survey with all the 50 state DOTs and District of Columbia to determine current road maintenance practices during the last 10 years. The state DOTs responded questions about factors that influenced their selection of In-House and Out-Sourcing methods. Further, the survey included questions related to the satisfaction level of DOTs with various benefits of In-House, MBC, and PBC methods. The DOTs rated the satisfaction levels for those three methods with regard to cost effectiveness, schedule advantage, quality delivered, and risk transfer. The survey results indicated that, on average, the respondents were more satisfied with the In-House method in comparison to MBC and PBC methods. The respondents stated that the In-House method yielded high cost savings and schedule effectiveness, and provided better quality and low risk to the DOTs. Lessons learned were identified pertaining to these contracting methods.

INTRODUCTION

The United State Department of Transportation (DOT) received $74 billion in 2013 for the construction and maintenance of the roads nationwide (USDOT 2013). Every year, the state Departments of Transportation (DOTs) spend a significant amount of this budget to maintain their road networks. Two ways that the DOTs maintain their road systems are with an In-House work force or by Out-Sourcing to the private contractor. Basically, there are two Out-Sourcing methods that the state DOTs use to maintain their highways. They are prescriptive-based contracting, or Method-Based Contracting (MBC) and Performance-Based Contracting (PBC). Nowadays, there are various kinds of PBC methods and hybrid methods.

Under the In-House method, the state DOTs maintain their road networks using their regular staff and equipment. In-House method is suitable for activities that require an emergency response and have few maintenance activities. In addition, it is suitable for bridge and tunnel work, shoulder maintenance, landscape works, and litter and debris pick-up (Anastasopoulos et al. 2010, NCHRP 2009, and Ribreau...
Emergency response activities in the winter season, from October 15 to April 30, are snow removal, anti-icing, and de-icing (Menches 2010).

State DOTs use the MBC method while Out-Sourcing the maintenance works to the contractors (NCHRP 2003). With this method, ‘Lowest-Bid’ is used most often to select the contractors. The MBC specification specifies to the contractor ‘what to do,’ ‘when to do it,’ and ‘how to do it’ (Stankevich et al. 2009). Generally, the MBC method is selected when the state DOTs lack the skilled workforce and have time constraints (NCHRP 2003). With this method, the payment to the contractor is based on contractor’s bid rate and a measurement of the work completed.

In 1988, the PBC method was introduced to maintain road systems in British Columbia, Canada (Zietlow 2004). This method uses ‘Best-Value’ and a qualification-based process for contractor selection. Because the specification used in this method is performance-based, the state DOTs focus on the work performance rather than work processes (Stankevich et al. 2009). The benefits of this method are risk transfer to the contractor, a maintenance fund that is available for a longer duration (more than three years), an increased Level of Service (LOS), bundling of maintenance activities, and cost-effectiveness (NCHRP 2003, NCHRP 2009, Ribreau 2003, Zietlow 2004, Zietsman 2004). Payment to the PBC contractor is based on the performance of the work done by them. The payment of the work increases commensurate to the quality.

The Hybrid contracting method, which is a combination of MBC and PBC uses two specifications, to maintain the roads (NCHRP 2009). As this method is a combination of two specifications, some activities are performed according to the one specification and others are performed using the second specification. Generally, a hybrid contract is used on large maintenance works.

This study conducted a questionnaire survey to 50 state DOTs and District of Columbia. The survey was developed to collect in-depth information regarding: current road maintenance practices; benefits of In-House, MBC, and PBC methods; factors influencing in selecting these methods; and satisfaction levels of the DOTs with the three methods regarding cost effectiveness, schedule advantage, quality delivered, and risk transfer.

In addition, questions were asked regarding the selection criteria for these three methods as well as lessons learned.

BACKGROUND STUDY

A study by Zietlow (2004) synthesizes the practices of PBC and the traditional contracting method. Traditional contracting, or MBC, focuses on work procedures. In this method, the contractor is paid on the basis of quantity of each activity completed and the contractor’s bid price. On the other hand, in PBC, the owner sets the work performance targets, and the contractor needs to meet these targets as described in the specification. Generally, the contract period of the PBC is longer than MBC. Further, the author suggested four advantages of PBC over MBC: 1) it reduces total maintenance costs, 2) it improves asset quality and standards, 3) it offers transparency to all people concerned with roads, and 4) it enhances overall road conditions as well as ensures greater satisfaction by road users.
Menches et al. (2010) studied the contracting methods used in preventive and routine maintenance in roadways of the United States. The study showed that one of the main reasons to choose Out-Sourcing for these services was low cost. Some of the other reasons for selecting Out-Source service was the lack of expertise within DOTs and an increased level of service (LOS). The authors concluded that various factors – including risk transfer from DOT to the contractor, requirement of a warranty for the contractor’s work, measurable performance criteria, and allocation of an administration team – influence the selection of the types of maintenance contracting methods.

Segal et al. (2003) described three types of Out-Sourcing contracts: MBC, PBC, and warranty contract. Their study found that the main reasons to choose the Out-Sourcing were cost efficiency, better quality, increased LOS, completion of work on time, and proper risk transfer. The study showed that after the U.S. government passed the Transportation Equity Act for the 21st Century, many states began Out-Sourcing services for their maintenance work. This study identified the type of the activities to be Out-Sourced; the type of activities to be bundled in one contract; and the types of delivery methods, contract specifications, and pricing strategy used during Out-Sourcing of the maintenance activities.

The National Cooperative Highway Research Program (NCHRP) study summarized the reasons to choose Out-Sourcing methods in maintaining roads (NCHRP 2003) were the availability of staffing in state DOTs, the complexity of work, cost efficiency, the work volume, and the type of maintenance work. Another study conducted by the NCHRP (2009) showed that the main advantages of PBC were cost savings, better quality, proper risk transfer from DOT to the contractor, and innovation. The disadvantages of this method were longer contracting processes, less competition among contractors, and loss of control towards the maintenance work. The study identified various types of PBC methods, such as single activity, single asset, a set of related activities, corridor, area-wide, hybrid, agency-to-agency, warranty-based, and multiphase.

NCHRP 2003 and 2009 study cover the use of Out-Sourcing methods in all the activities used by state DOTs, however this study focused the survey in collecting data only related to road maintenance activities of state DOTs. Also the respondents involved in this study are the state DOT maintenance engineers however in the previous survey, the respondents were the decision makers of the state DOTs.

OBJECTIVES
The major objectives of this study are to identify the factors affecting the selection of in-house and Out-Sourcing road maintenance methods, and to measure the state DOTs’ satisfaction level on the benefits of in-house and Out-Sourcing road maintenance methods.

METHODOLOGY
In order to collect current road maintenance practices of the state DOTs, a questionnaire survey was developed and sent to the 50 state DOTs and District of Columbia. The survey consisted of four sections related to In-House and Out-Sourcing contracting methods: 1) General Information; 2) Road Maintenance...
Specifications Methods; 3) Satisfaction Level; and 4) Performance Assessment of In-House, MBC, and PBC Methods.

The first section included general information about the respondents, such as name of the agency, name of the road maintenance engineer, and contact information. The second section asked for information about the state DOTs’ practices regarding road maintenance, including various methods used, the selection criteria, benefits of In-House and Out-Sourcing methods, and lessons learned. The third section of the survey involved rating the satisfaction levels for these three methods with regard to cost effectiveness, schedule advantage, quality delivered, and risk transfer. The final section consisted of assessing the performance of In-House, MBC, and PBC methods. This section also included the lessons learned by state DOTs while using these methods.

SURVEY RESULTS
Types of road maintenance contracting methods

About 31% of the DOTs (15) responded to the questionnaire survey. All DOTs who responded the survey used the In-House and MBC method, and about 27% used the PBC method for maintaining their road activities (Figure 1).

![Figure 1. Road maintenance contracting methods used by State DOTs](image)

Selection of road maintenance contracting methods

The questionnaire survey listed seven factors that could influence the selection of In-House and Out-Sourcing methods for road maintenance works. The state DOTs were asked to rate the importance of these factors on a 1-5 scale, 5 being most important and 1 being not important. The average importance ratings for each of the factors are shown in Figure 2. The results showed that ‘Availability of DOT staff’ was the most important factor, followed by ‘DOT have specific skill for the job,’ ‘Quality of work,’ ‘To complete the task within budget,’ ‘Budget constraint,’ ‘Time constraint,’ and ‘To complete the task within schedule.’ The ‘Budget constraint’ is defined as deficiency of fund at the planning phase of road maintenance
whether ‘To complete the task within budget’ refers to complete the task within the allocated budget amount. Similarly, ‘Time constraint’ is defined as limitation of time before a road maintenance starts whether ‘To complete the task within schedule’ refers to complete the task within allocated time frame. The prior studies showed that several agencies Out-Source road maintenance works to the private contractors when the state DOTs do not have right personnel or skilled people for a specific maintenance works, for example bridge pier maintenance.

![Figure 2](image)

**Figure 2. Factors affecting the selection of in-house method**

Similarly, the state DOTs were asked to rate the importance of the factors in selecting the Out-Sourcing method for road maintenance works. The average importance ratings for each of the factors are shown in Figure 3. The results showed that ‘Lack of DOT staff” was the most influential factor in choosing Out-Sourcing, followed by ‘Lack of skilled manpower in DOT,’ and ‘Time constraint’ (Figure 3).
Out of 15, only four DOTs used the PBC method for their road maintenance activities. Based on those four responses, the major three factors that affect the selection of PBC method are: availability of staff in DOT, to save money, and innovation.

**Satisfaction level with benefits of road maintenance contracting methods**

Respondents were asked to rate the satisfaction levels with the benefits of the In-House, MBC, and PBC methods. Out of 15 respondents, 14 DOTs rated their satisfaction levels, shown in Figure 4. The results show that the respondents were highly satisfied with the In-House method (4.2), followed by the MBC (3.5), and the PBC (3.3) for this sample.
advantage, quality delivered, and risk transfer. The rating was done on a scale of 1 to 5; 5 being highly satisfied and 1 being very dissatisfied.

The mean satisfaction levels of these benefits, shown in Figure 5, indicate that the DOTs were highly satisfied with the In-House method in comparison to the MBC and the PBC in all of these five categories for this sample. However, the respondents were more satisfied with the PBC as compared to MBC in terms of risk transfer.

![Figure 5. Mean satisfaction level with benefits of in-house, MBC, and PBC methods](image)

**Lessons learned using various road maintenance contracting methods**

Further, ‘lessons learned’ were collected using the In-House, MBC, and PBC methods, and grouped together by the pattern of responses. The frequencies of the items mentioned by the respondents were recorded, and the top three lessons learned were identified.

The major lesson in using the In-House method was that the DOT should make sure that there were enough crew and staff members to conduct the specified tasks. The top three important lessons learned for this sample were: there should be enough crew and staff members for specified tasks; the work must be correctly specified; and in-house does better work with less money.

Similarly, for the MBC method, the top three lessons learned for this sample are listed below, and are related to the scope of work, contract requirements, and understanding of contracting by DOT staff.

Ensure specifications and contract requirements are clear and concise; otherwise, a contractor may take advantage of the DOT.

The work and language must be correctly specified.
DOT inspectors and administrators must understand and embrace the contracting method.

For this sample, the top three lessons learned with the PBC method were related to setting up performance standards, scoping, and contract selection methods. The top three lessons were: determine adequate performance standards; for long-term PBC, write the ‘dynamic’ scope; and use the ‘Best-Value’ method, and give more weight to the technical proposal.

CONCLUSIONS AND RECOMMENDATIONS

This study analyzed the data of 15 DOTs who responded to the survey in order to determine current methods used for road maintenance contracting. The data analysis was conducted with the responses collected up until the present.

The results showed that almost all DOTs used the In-House and MBC methods for their road maintenance activities for this sample. However, only four out of 15 DOTs used the PBC method to maintain their road assets. The survey identified that the availability of DOT staff was the most important factor in selecting the In-House or Out-Sourcing method for this sample; this factor was also included in NCHRP 2003 study as one of the main reason for Out-Sourcing a contract.

Based on rating of satisfaction levels, DOTs were highly satisfied with the In-House method as compared to the MBC and PBC methods; however, DOTs who used the PBC method (4 out of 15) indicated that they were more satisfied with the PBC method than the MBC method with regard to transferring risk to the contractors for this sample. Comparing with the NCHRP 2003 survey, our survey showed the satisfaction level for overall experience of Out-Sourcing method was 4.5 on the scale of 1 to 5, which is higher than the NCHRP 2003 survey (7.55 on 1-10 scale).

The respondents provided lessons learned from their experiences using the In-House, MBC, and PBC methods. The survey respondents mentioned that the In-House method is more cost effective than the MBC and PBC methods. Therefore, the cost data was analyzed for the In-House and MBC methods to determine whether the In-House was more cost effective than the MBC, in actuality.

The authors recommend conducting a study to determine the life-cycle cost analysis of road maintenance activities performed using the In-House, MBC, and PBC methods.

LIMITATIONS

This study intends to provide subjective perception of the state DOTs regarding current methods used for road maintenance contracting and the results were concluded from their responses. As this study is going on, the responses from the state DOTs were also limited (15 responses) and the data is not sufficient to conduct statistical analysis. The authors are planning to conduct statistical analysis and submit the broader version of this paper in reputed construction journal after the data collection is completed.

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