
Research Report
KTC-91-3

COST EFFECTIVE MAINTENANCE
CONTRACTING - A LITERATURE REVIEW

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May 1991

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| 1. Report No. KTC-91-3 | 2. Government Accession No. | 3. Recipient's Catalog No. | |
| 4. Title and Subtitle Cost Effective Maintenance Contracting -- A Literature Review | | 5. Report Date May 1991 | 6. Performing Organization Code |
| 7. Author(s) Bobby W. Meade and David Q. Hunsucker | 8. Performing Organization Report No. KTC-91-3 | | 10. Work Unit No. (TRAVIS) |
| 9. Performing Organization Name and Address Kentucky Transportation Center College of Engineering University of Kentucky Lexington, KY 40506-0043 | | 11. Contract or Grant No. KYHPR-91-137 | 13. Type of Report and Period Covered Interim |
| 12. Sponsoring Agency Name and Address Kentucky Transportation Cabinet State Office Building Frankfort, KY 40622 | | 14. Sponsoring Agency Code NCP Code 4E5F1162 | |
| 15. Supplementary Notes Prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration. | | | |
| 16. Abstract <p>Faced with ever increasing maintenance needs and constrained resources for meeting those needs, government agencies are searching for the most cost effective means of conducting highway maintenance. One alternative being used is contracting highway maintenance to private agencies. This report includes the findings of a literature search of articles pertaining to contract maintenance.</p> <p>Review of the articles acquired in the literature search indicates that contract maintenance is increasing in usage and is a cost effective alternative.</p> | | | |
| 17. Key Words Cost Effective Contract Maintenance In-house Private Agency | | 18. Distribution Statement Unlimited with approval of Kentucky Transportation Cabinet | |
| 19. Security Classif. (of this report) Unclassified | 20. Security Classif. (of this page) Unclassified | 21. No. of Pages 17 | 22. Price |

EXECUTIVE SUMMARY

Cost Effective Maintenance Contracting

KYHPR 91-137

This report includes the findings of a literature search and review of articles and reports concerning contract maintenance. The literature search was conducted to address Objective A of KYHPR 91-137 "Cost Effective Maintenance Contracting". Approximately 35 articles were acquired and reviewed. Abstracts of all pertinent articles were combined to form a body of information.

Published information indicates that contracting highway maintenance is a steadily increasing activity. The level of contract maintenance usage (percent of total maintenance expenditures) has increased from approximately 7 percent to 50 percent in 30 years. Indications are that the trend will continue.

Contract maintenance usually occurs in one of two types. The most common type is a contract for a specific maintenance activity for a specific project. The other type, which is more common outside the United States, is a contract for general maintenance of a particular area or section of highway. Both types have been shown to be cost effective when compared to maintenance performed by in-house personnel.

The most cost effective alternative appears to be contracting specific activities with a cost analysis of each activity. The maintenance work program would consist of contracts for activities where significant savings would be realized and completion of remaining activities with in-house personnel. This would permit substantial savings yet retain a well trained core of in-house personnel.

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INTRODUCTION

Due to several factors, the effort of maintaining our nations highways has increased in both difficulty and complexity. Changes in technology, increasing mileage of highway, increasing traffic volume, aging of the highway system, changing priorities, and constrained resources have all contributed to the complexity and difficulties of the current maintenance effort. Constrained resources, in particular, demand constant evaluation and selection of the most efficient maintenance programs to obtain the greatest utility of maintenance dollars.

One mechanism being used to address the maintenance situation is the use of contract maintenance. Contract maintenance has been used for many years; but in the past 30 years, its popularity has increased dramatically. In the 1960's, contract maintenance was performed by a few agencies and usually for a limited number of activities.

An article published in 1973 (1) indicated that contract maintenance had increased from 7.2 percent of the nationwide state maintenance budget in 1959, to 7.6 percent in 1969, to 9.5 percent in 1970, and to 14.3 percent in 1972. In 1990, a survey of 79 agencies from all levels of government indicated that roughly 50 percent of maintenance work would be contracted for 1990 and 1991 (2).

The Kentucky Department of Highways has been contracting with private agencies to perform some maintenance activities. From June 1989 to December 1990, there were 48 maintenance activities that were contracted at least once. Seven maintenance activities accounted for 50 percent of approximately 280 contracts awarded during that time. Those activities included surface patching, miscellaneous shoulder maintenance, litter pickup, guardrail repair, and mowing. The decision to use contract maintenance has been primarily based on the availability of agency resources, in particular the availability of personnel, equipment, and expertise. The question of the cost effectiveness of maintenance activities performed by state forces or by private agency contract has become very important.

In 1990, the Kentucky Department of Highways in conjunction with the Federal Highway Administration initiated a study to address the cost effectiveness of contract maintenance. Objective A, of that study, was to conduct a literature search and review to document current state-of-the-art procedures used to evaluate the desirability and feasibility of contracting highway maintenance activities by public agencies. This report addresses that objective.

LITERATURE SEARCH

The literature search resulted in the acquisition of approximately 35 articles. Many of the articles were included in a bibliography obtained through the Highway Research Information Service (HRIS). Other articles were obtained from references included in the HRIS articles. Upon review, it was determined that approximately one-third of the articles were either interim reports or final reports included in the search or contained peripheral information and, thus were of little use for our purpose. The pertinent articles were abstracted to form a body of information.

The abstracted articles were noted to be in one of three general types. One type included results of surveys which usually requested information relative to the level of contract maintenance usage, types of activities contracted, and satisfaction with contracted activities. A second type included case studies of agencies using contract maintenance. Typically, a limited number of contracted activities for a particular agency were investigated. Contracting agencies were almost invariably content with contractor performance. The third type concerned methodologies for identifying the various costs involved in maintenance by contract and maintenance by in-house personnel. The third type included some methodologies for the "make versus buy" decision, i.e., should a maintenance activity be performed by in-house staff or should it be contracted through a private agency.

Two things were apparent from the literature review. The first was that both the usage of contract maintenance and satisfaction with contractor performance are steadily increasing. A survey published in 1971 included responses from 24 state highway departments and county highway departments (3). Eight respondents indicated no use of contract maintenance, five indicated extensive use, and 11 indicated limited usage. Limited usage usually involves contracting a few specific maintenance activities where in-house resources (personnel, equipment, or expertise) are not available or sufficient for the task. Cost effectiveness appeared to be a factor only to the five respondents indicating extensive use of contract maintenance.

The second observation that was apparent from the literature review was that agencies contracting maintenance work generally do not have a methodology for determining the cost effectiveness of the chosen means of accomplishing the work. Reducing government spending has become a popular theme and the most obvious means of reduction is decreasing the number of personnel. The amount of maintenance required continues to increase; therefore, maintenance work is contracted due to insufficient personnel. That is not to say that contracting is not cost effective, it merely says that cost effectiveness is often not a factor in the decision to contract.

Information acquired during the review indicates that contracting, in nearly all cases, is either less expensive or equal in cost to maintenance performed by in-house personnel. A 1980 publication states that several public agencies contract all of their public works maintenance and have reduced their costs by as much as 30 percent (4). The same

publication states that the Florida Department of Transportation let selected maintenance activities to bid, adjusted the bids upward by 31 percent (overhead and supervision) and, after adjustment, the bids were 15 percent less than the cost of using state forces.

TYPES OF MAINTENANCE CONTRACTS

Maintenance contracts in Kentucky have been used on an activity basis (periodic) rather than a general maintenance basis (routine). Several countries and some agencies in the United States have used routine maintenance contracts. In most cases, the practice has been very successful. Yugoslavia has used routine maintenance contracts since the late 1950's (5). The system has developed to the point where, in one case, five inspectors and a director control maintenance for 4,700 km. (2,920 miles) of roads. The Yugoslavian roads are of high standard, are well maintained, and a high degree of professionalism in the industry has evolved. The Yugoslavian road authority consists of 185 people in its entirety!

Some of the arguments for routine maintenance contracts are; the reduction of government personnel to a minimum, development of a professional and diversified private industry, less expensive maintenance, and probably a more influential lobby for increased maintenance dollars.

Some of the perceived problems with routine maintenance contracts are; monopolization, corruption, and loss of agency control due to inability to perform maintenance work. Corruption is a possibility in either private industry or government and therefore is not a controlling factor in the decision to use contract maintenance. Argentina addressed most of these perceived problems by retaining 30 percent of its maintenance for in-house completion (5). The in-house work in each district is managed as if it were a contract in competition with private industry. This permitted a significant reduction of in-house personnel, upgrading of the remaining personnel, provided a gauge for planning and costs, and retained a well trained nucleus for direct action or expansion of in-house capability.

The more common type of maintenance contracting is contracting for a specific maintenance activity on a project rather than long-term basis. This type of contracting is usually undertaken when a maintenance need cannot be readily met by existing in-house resources. The need might be a seasonal one where the need for personnel and/or equipment is short term. The need might be for an activity requiring a skill, speciality, or equipment not available in-house. Contracting maintenance on this basis allows the contracting agency to maintain a stable core of equipment and personnel to perform regular maintenance duties and allows for flexibility in the overall work program.

Many agencies are now beginning to view contract maintenance, whether as routine or on an activity basis, as a tool to achieve maximum efficiency in their maintenance operations. While routine maintenance contracts have been shown to be cost effective as

compared to in-house maintenance (5,6), the greatest opportunity appears to lie in the careful selection of maintenance activities contracting. This approach allows the contracting agency to contract those activities where substantial savings occur, reduce in-house personnel, yet maintain a flexible core of qualified personnel. This approach requires a clear understanding of the agency's maintenance needs, cost of fulfilling those needs in-house, and cost of fulfilling those needs by private contractors. The costs must be identified on an activity basis. An example of this method as reported in reference 6 is shown in Tables 1 and 2.

Probably because cost effectiveness has not been a major factor in the decision to use contract maintenance, there was little information on established methods for cost effective decision making. A limited number of articles were located wherein an attempt to develop a workable cost effective decision methodology was reported. In one case, the cost analysis used was based on a total maintenance package for the basic maintenance unit (county) in that state (7). The authors of that article did not attempt to compare relative costs of contract and in-house maintenance, instead the total maintenance costs for two representative counties were determined. The total costs were then used to develop a factor against which bids could be compared. The cost analysis included in the article is similar to the routine maintenance discussed earlier.

A limited number of articles included discussions of attempts to identify the various costs (fixed costs, direct variable costs, and direct variable overhead) involved with maintenance programs. The attempts usually appeared to be detailed and thorough when addressing in-house costs. Procurement and administration costs accrued by the contracting agency when contracting maintenance are typically included with the contract bid for purposes of cost analysis. In these same analyses, costs accrued for inspection and savings resulting from reduction of in-house resources are not commonly included.

The decision to use contract maintenance typically rests with the resident engineer with the concurrence of district and central office staff. The decision at the resident level is usually based on the quantity of work, time frame, and in-house resources available. Appendix A includes a flow chart outlining a proposed method for the decision process. The method was presented in a report by Allen and Lisle (6). The flow chart contains some of the deficiencies previously mentioned but appears to be representative of the methods commonly used.

ADVANTAGES AND DISADVANTAGES

Review of several case studies and surveys led to the identification of some re-occurring advantages as perceived by the contracting agencies. Those advantages are;

1. reduction of capitol expenditures on equipment and facilities needed seasonally,
2. reduction of capitol expenditures on new processes and techniques,
3. greater flexibility in executing work programs,

Table 1*
Hypothetical Maintenance Operations
Cost Example

| Items | Examples | | | | |
|---|---------------|----------------------|---------------|--------------|----------------|
| | Mowing | Machine Shoulders | Ditching | Guardrail | Total |
| Labor & Equip. | \$ 75,000 | \$ 93,000 | \$ 23,000 | \$ 3,200 | \$194,200 |
| Materials | 0 | 0 | 0 | 3,200 | 3,200 |
| Variable Overhead | 2,000 | 1,600 | 630 | 300 | 4,530 |
| Total Variable Cost | 77,000 | 94,600 | 23,630 | 6,700 | 201,930 |
| Fixed Cost | 15,400 | 21,758 | 4,978 | 1,273 | 43,409 |
| Total Cost | 92,400 | 116,358 | 28,608 | 7,973 | 245,339 |
| Contract Price | 81,000 | 83,000 | 23,620 | 6,300 | 193,920 |
| Excess Contract Price over Variable Cost | \$ 4,000 | - \$ 11,600 | - \$ 10 | - \$ 400 | - \$ 8,010 |

* Allen, G.R. and Lisle, F.N., "Analysis of Maintenance Costing with Emphasis on Contracting Versus Using State Forces," Virginia Highway and Transportation Research Council, VHTRC 83-R5, September, 1982.

Table 2*

Comparative Costs for All and Selected Maintenance Operations

If all operations done by state forces, cost would be

| | |
|---------------------------|-----------|
| Total variable cost | \$201,930 |
| Total fixed cost | 43,409 |
| Total cost | \$245,339 |

If all operations were contracted, cost would be

| | |
|----------------------------|-----------|
| Total contract price | \$193,920 |
| Total fixed cost | 43,409 |
| Total cost | \$237,329 |

If mowing and ditching done in-house and machining shoulders and guardrail work were contracted, cost would be

| | |
|----------------------------------|-----------|
| Variable cost (Mowing) | \$ 77,000 |
| Variable cost (Ditching) | 23,630 |
| Contract price (Shoulders) | 83,000 |
| Contract price (Guardrail) | 6,300 |
| Total fixed cost | 43,409 |
| Total cost | \$233,339 |

* Allen, G.R and Lisle, F.N., "Analysis of Maintenance Costing with Emphasis on Contracting Versus Using State Forces," Virginia Highway and Transportation Council, VHTRC 83-R5 September, 1982.

4. reduction of in-house training for specialized work,
 5. requires efficiency of in-house management practices,
 6. reduction of in-house personnel,
-
7. the private sector has great incentive (through competition) to continue to improve productivity,
 8. develops local economy, and
 9. case studies have shown that private agencies typically provide the required quantities and quality of maintenance at less cost than with in-house resources.

Some commonly identified disadvantages as perceived by the contracting agencies are;

1. increase in paperwork through addition of another level of administration,
2. existing in-house structure not designed for contract maintenance management,
3. loss of direct control of quality,
4. deterioration of in-house resources and capabilities,
5. inability to reverse a deterioration trend due to the huge initial costs for re-equipping and rehiring, and,
6. contractor insensitivity to agency and public objectives.

It appears that restructuring of in-house administration and management procedures could eliminate most of the listed disadvantages.

CONCLUSIONS

Over the past 30 to 35 years, the use of contract maintenance has continually increased. It is estimated that from a nationwide average of 7.2 percent of all state maintenance in 1959, the use of contract maintenance has increased to 50 percent or greater at the present. Practically all published literature indicates that the practice is successful. A product of sufficient quality and quantity at a reduced cost is usually produced.

In most cases, cost has not been a determining factor in the decision to use contract maintenance. The decision has typically been based on the availability of in-house resources (primarily personnel, equipment, and expertise). Many agencies report satisfaction with the practice and continue to use it with only a general knowledge of the cost effectiveness of contract maintenance. In case studies where contract maintenance has been used and an attempt has been made to analyze cost effectiveness, contract maintenance is a cost effective alternative to in-house maintenance.

Within the United States, contract maintenance is usually performed on an activity basis with a limited amount of routine or general maintenance contracts. Outside the United States, routine maintenance contracts appear to be more common. Both types have been shown to be successful. Routine maintenance contracts reduce agency personnel to a minimum.

The most economical highway maintenance program appears to be one in which the various costs are identified and contract bids plus applicable costs are compared to in-house costs. These costs and bids are identified on an activity basis. The maintenance work program would then be the most economical combination of contracted and in-house performed work. It should be noted that as the percentage of contract to total work increases, fixed costs associated with general administration, accounting, insurance, etc. would probably decrease.

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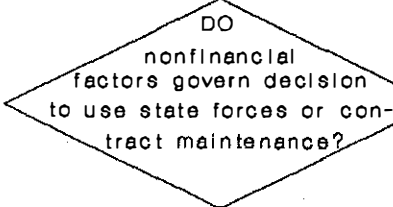
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APPENDIX A

Flowchart for In-house Versus Contract Maintenance Decision Analysis *

- * Allen, G.R and Lisle, F.N., "Analysis of Maintenance Costing with Emphasis on Contracting Versus Using State Forces," Virginia Highway and Transportation Council, VHTRC 83-R5 September, 1982.

Identify nonfinancial factors such as quality of work, manpower, equipment, expertise, etc., for each maintenance activity to be performed during this budget or planning period.



YES

Base decision on nonfinancial factors (the number of activities here should be minimal).

NO

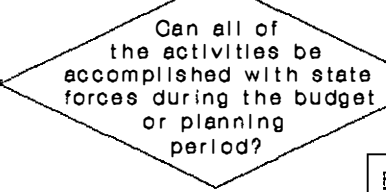
COMPUTE DIRECT VARIABLE COSTS
1. Estimate units of direct labor, units of material, hours of equipment, inspection hours, and any subcontract costs.
2. Multiply units by appropriate units costs.
3. Add 41.7% to full-time labor and 6.7% to hourly labor except convict labor.

COMPUTE VARIABLE OVERHEAD COSTS
1. Estimate material handling and delivery costs; testing, drafting and engineering where applicable; foremanship; indirect shop labor (gauges, tools, etc.); fuel costs; travel to and from job site; special training costs; and set up and tear down costs for equipment.
2. Multiply labor units by appropriate unit costs.
3. Add 41.7% to full-time labor and 6.7% to any hourly labor.

THE TOTAL STATE FORCE VARIABLE COST is obtained by adding the direct variable costs to the variable overhead costs.

CONTRACT COSTS
1. Determine which type of contract is best suited for this work
a. general maintenance contract
b. maintenance activity contract
2. Write specifications for comparable work.
3. Obtain bids from contractors.

COMPARE STATE FORCE VARIABLE COSTS AND CONTRACT COSTS



NO

YES

RESIDENCY CAPACITY EXCEEDED
Use state forces for those activities where contract cost exceeds state force variable cost (in descending order of the cost margin) until capacity is reached. Let remaining activities to contract until budget is exhausted.

RESIDENCY CAPACITY NOT EXCEEDED
Let to contract only those activities for which the contract cost is less than the state force variable cost by a significant margin. All other activities should be performed with state forces until budget is exhausted.