

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
SYNTHESIS OF HIGHWAY PRACTICE

125

MAINTENANCE ACTIVITIES
ACCOMPLISHED BY CONTRACT

TRANSPORTATION RESEARCH BOARD EXECUTIVE COMMITTEE 1986

Officers

Chairman

LESTER A. HOEL, *Hamilton Professor and Chairman, Department of Civil Engineering, University of Virginia*

Vice Chairman

LOWELL B. JACKSON, *Secretary, Wisconsin Department of Transportation*

Secretary

THOMAS B. DEEN, *Executive Director, Transportation Research Board*

Members

RAY A. BARNHART, *Federal Highway Administrator, U.S. Department of Transportation (ex officio)*
JOSEPH M. CLAPP, *President and Vice Chairman, Roadway Services, Inc. (ex officio, Past Chairman, 1984)*
JOHN A. CLEMENTS, *President, New England Fuel Institute (ex officio, Past Chairman, 1985)*
DONALD D. ENGEN, *Federal Aviation Administrator, U.S. Department of Transportation (ex officio)*
FRANCIS B. FRANCOIS, *Executive Director, American Association of State Highway and Transportation Officials (ex officio)*
RALPH STANLEY, *Urban Mass Transportation Administrator, U.S. Department of Transportation (ex officio)*
DIANE STEED, *National Highway Safety Administrator, U.S. Department of Transportation (ex officio)*
GEORGE H. WAY, *Vice President for Research and Test Department, Association of American Railroads (ex officio)*
ALAN A. ALTSHULER, *Dean, Graduate School of Public Administration, New York University*
JOHN R. BORCHERT, *Regents Professor, Department of Geography, University of Minnesota*
ROBERT D. BUGHER, *Executive Director, American Public Works Association, Chicago*
DANA F. CONNORS, *Commissioner, Maine Department of Transportation*
MORTIMER L. DOWNEY, *Deputy Executive Director for Capital Programs, Metropolitan Transportation Authority, New York*
THOMAS E. DRAWDY, SR., *Secretary of Transportation, Florida Department of Transportation*
PAUL B. GAINES, *Director of Aviation, Houston Department of Aviation*
JACK R. GILSTRAP, *Executive Vice President, American Public Transit Association, Washington, D.C.*
WILLIAM K. HELLMANN, *Secretary, Maryland Department of Transportation*
JOHN B. KEMP, *Secretary, Kansas Department of Transportation*
ALAN F. KIEPPER, *General Manager, Metropolitan Transit Authority, Houston*
JAMES E. MARTIN, *President and Chief Operating Officer, Illinois Central Gulf Railroad*
DENMAN K. McNEAR, *Chairman, Southern Pacific Transportation Company*
FRED D. MILLER, *Director, Oregon Department of Transportation*
JAMES K. MITCHELL, *Professor, Department of Civil Engineering, University of California, Berkeley*
H. CARL MUNSON, JR., *Vice President—Corporate, The Boeing Commercial Airplane Company*
MILTON PIKARSKY, *Distinguished Professor of Civil Engineering, City College of New York*
HERBERT H. RICHARDSON, *Vice Chancellor and Dean of Engineering, Texas A&M University*
LEO J. TROMBATORE, *Director, California Department of Transportation*
CARL S. YOUNG, *Broome County Executive, New York*

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Transportation Research Board Executive Committee Subcommittee for the NCHRP

JOHN A. CLEMENTS, *New England Fuel Institute (Chairman)*
RAY A. BARNHART, *Federal Highway Administration*
JOSEPH M. CLAPP, *Roadway Express, Inc.*

FRANCIS B. FRANCOIS, *Amer. Assoc. of State Hwy. & Transp. Officials*
LESTER A. HOEL, *University of Virginia*
THOMAS B. DEEN, *Transportation Research Board*

Field of Special Projects

Project Committee SP 20-5

VERDI ADAM, *Louisiana Dept. of Transp. and Development (Chairman)*
ROBERT N. BOTHMAN, *Oregon Dept. of Transportation*
JACK FRIEDENRICH, *New Jersey Dept. of Transportation*
DAVID GEDNEY, *De Leuw, Cather and Company*
RONALD E. HEINZ, *Federal Highway Administration*
JOHN J. HENRY, *Pennsylvania Transportation Institute*
BRYANT MATHER, *USAE Waterways Experiment Station*
THOMAS H. MAY, *Pennsylvania Dept. of Transportation*
EDWARD A. MUELLER, *Morales and Shumer Engineers, Inc.*
EARL SHIRLEY, *California Dept. of Transportation*
JON UNDERWOOD, *Texas Dept. of Highways and Public Transportation*
ROBERT J. BETSOLD, *Federal Highway Administration (Liaison)*
K. B. JOHNS, *Transportation Research Board (Liaison)*

Program Staff

ROBERT J. REILLY, *Director, Cooperative Research Programs*
ROBERT E. SPICHER, *Deputy Director, Cooperative Research Programs*
LOUIS M. MacGREGOR, *Administrative Engineer*
IAN M. FRIEDLAND, *Projects Engineer*
CRAWFORD F. JENCKS, *Projects Engineer*
R. IAN KINGHAM, *Projects Engineer*
HARRY A. SMITH, *Projects Engineer*
HELEN MACK, *Editor*

TRB Staff for NCHRP Project 20-5

DAMIAN J. KULASH, *Assistant Director for Special Projects*
THOMAS L. COPAS, *Special Projects Engineer*
HERBERT A. PENNOCK, *Special Projects Engineer*
ANNE S. BRENNAN, *Editor*
EMMA LITTLEJOHN, *Secretary*

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
SYNTHESIS OF HIGHWAY PRACTICE **125**

MAINTENANCE ACTIVITIES ACCOMPLISHED BY CONTRACT

CLIFFORD C. McMULLEN
Byrd, Tallamy, MacDonald & Lewis
Falls Church, Virginia

Topic Panel

ADRIAN G. CLARY, *Transportation Research Board*
CHARLES R. MILLER, *Florida Department of Transportation*
H. JAMES SPELMAN, JR., *D.C. Department of Transportation*
DALE VANDENBERG, *Wyoming Highway Department*
P. E. CUNNINGHAM, *Federal Highway Administration (Liaison)*

RESEARCH SPONSORED BY THE AMERICAN
ASSOCIATION OF STATE HIGHWAY AND
TRANSPORTATION OFFICIALS IN COOPERATION
WITH THE FEDERAL HIGHWAY ADMINISTRATION

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL
WASHINGTON, D.C.

JULY 1986

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway and Transportation Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board of the National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as: it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; its relationship to the National Research Council is an assurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the National Research Council and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are the responsibilities of the National Research Council and its Transportation Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

NOTE: The Transportation Research Board, the National Research Council, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the individual states participating in the National Cooperative Highway Research Program do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

Project 20-5 FY 1982 (Topic 14-07)

ISSN 0547-5570

ISBN 0-309-04011-6

Library of Congress Catalog Card No. 86-50376

Price: \$8.00

Subject Areas

Administration

Maintenance

Mode

Highway Transportation

NOTICE

The project that is the subject of this report was a part of the National Cooperative Highway Research Program conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council. Such approval reflects the Governing Board's judgment that the program concerned is of national importance and appropriate with respect to both the purposes and resources of the National Research Council.

The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation Officials, or the Federal Highway Administration of the U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical committee according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

The National Research Council was established by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and of advising the Federal Government. The Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in the conduct of their services to the government, the public, and the scientific and engineering communities. It is administered jointly by both Academies and the Institute of Medicine. The National Academy of Engineering and the Institute of Medicine were established in 1964 and 1970, respectively, under the charter of the National Academy of Sciences.

The Transportation Research Board evolved in 1974 from the Highway Research Board, which was established in 1920. The TRB incorporates all former HRB activities and also performs additional functions under a broader scope involving all modes of transportation and the interactions of transportation with society.

Published reports of the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

are available from:

Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

PREFACE

A vast storehouse of information exists on nearly every subject of concern to highway administrators and engineers. Much of this information has resulted from both research and the successful application of solutions to the problems faced by practitioners in their daily work. Because previously there has been no systematic means for compiling such useful information and making it available to the entire highway community, the American Association of State Highway and Transportation Officials has, through the mechanism of the National Cooperative Highway Research Program, authorized the Transportation Research Board to undertake a continuing project to search out and synthesize useful knowledge from all available sources and to prepare documented reports on current practices in the subject areas of concern.

This synthesis series reports on various practices, making specific recommendations where appropriate but without the detailed directions usually found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems. The extent to which these reports are useful will be tempered by the user's knowledge and experience in the particular problem area.

FOREWORD

*By Staff
Transportation
Research Board*

This synthesis will be of interest to maintenance engineers, administrators, and others concerned with performing maintenance functions by contract. Information is presented on current practices of agencies in contracting maintenance, on criteria for deciding to use contract maintenance, and on organizing and implementing a contract maintenance program.

Administrators, engineers, and researchers are continually faced with highway problems on which much information exists, either in the form of reports or in terms of undocumented experience and practice. Unfortunately, this information often is scattered and unevaluated, and, as a consequence, in seeking solutions, full information on what has been learned about a problem frequently is not assembled. Costly research findings may go unused, valuable experience may be overlooked, and full consideration may not be given to available practices for solving or alleviating the problem. In an effort to correct this situation, a continuing NCHRP project, carried out by the Transportation Research Board as the research agency, has the objective of reporting on common highway problems and synthesizing available information. The synthesis reports from this endeavor constitute an NCHRP publication series in which various forms of relevant information are assembled into single, concise documents pertaining to specific highway problems or sets of closely related problems.

Maintenance managers have been looking for new ways to perform maintenance functions at the lowest acceptable cost. This report of the Transportation Research Board describes how agencies are using contract maintenance as an alternative to accomplishing maintenance programs solely with agency personnel and equipment.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, the Board analyzed available information assembled from numerous sources, including a large number of state highway and transportation departments. A topic panel of experts in the subject area was established to guide the researcher in organizing and evaluating the collected data, and to review the final synthesis report.

This synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As the processes of advancement continue, new knowledge can be expected to be added to that now at hand.

CONTENTS

1	SUMMARY
3	CHAPTER ONE CONTRACT MAINTENANCE
	Introduction, 3
	Background, 3
	Pros and Cons of Contracting, 3
	Definitions, 4
	Trends, 4
6	CHAPTER TWO CURRENT PRACTICES
	Data Sources, 6
	Maintenance Activities Contracted by Highway and Public Works Agencies, 6
	Agencies Using Contract Maintenance, 8
	Factors Used in Deciding to Contract for Maintenance Activities, 8
	Cost Comparison Factors, 10
	Administrative or Legal Impediments, 12
	Types of Contracts Used, 14
	Contracting Approach Used, 14
	Contract Administration, 14
	Agency's Evaluation of Contracting Maintenance Activities, 15
19	CHAPTER THREE DECIDING TO CONTRACT
	Introduction, 19
	Decision Process, 19
	Determining the Need to Contract, 21
	Determining the Feasibility of Contracting, 21
	Determining the Desirability of Contracting, 24
	Costs, 24
27	CHAPTER FOUR IMPLEMENTING THE CONTRACTING DECISION
	Introduction, 27
	Organizing for Contracting Maintenance Activities, 27
	Implementation, 30
36	CHAPTER FIVE RESEARCH NEEDS
	Guide Specifications, 36
	Inspection and Quality Control, 36
37	BIBLIOGRAPHY
38	APPENDIX SUMMARY OF RESPONDENTS AND ACTIVITIES CONTRACTED

ACKNOWLEDGMENTS

This synthesis was completed by the Transportation Research Board under the supervision of Damian J. Kulash, Assistant Director for Special Projects. The Principal Investigators responsible for conduct of the synthesis were Thomas L. Copas and Herbert A. Pennock, Special Projects Engineers. This synthesis was edited by Anne S. Brennan.

Special appreciation is expressed to Clifford C. McMullen, Byrd, Tallamy, MacDonald & Lewis, who was responsible for the collection of the data and the preparation of the report.

Valuable assistance in the preparation of this synthesis was provided by the Topic Panel, consisting of Charles R. Miller, State Safety Engineer, Florida Department of Transportation; H. James Spelman, Jr., Assistant Director, Bureau of Construction & Maintenance, D.C. Department of Transportation; Dale Vandenberg, State Construction and Maintenance Engineer, Wyoming Highway Department; and Liaison Member P. E. Cunningham, Chief, Construction and Maintenance Division, Federal Highway Administration.

Adrian G. Clary, Engineer of Maintenance, Transportation Research Board, assisted the NCHRP Project 20-5 Staff and the Topic Panel.

Information on current practice was provided by many highway and transportation agencies. Their cooperation and assistance were most helpful.

MAINTENANCE ACTIVITIES ACCOMPLISHED BY CONTRACT

SUMMARY

As emphasis of the U.S. highway program has shifted from construction to maintenance, maintenance managers have devoted considerable attention to finding new ways of performing maintenance activities at the lowest acceptable cost. One method being tried is the contracting of some activities as an alternative to accomplishing maintenance programs solely with agency personnel and equipment.

Of 75 maintenance agencies surveyed for this synthesis, all but four are using contract maintenance to some extent. The maintenance activities most frequently mentioned as being contracted were maintenance overlays, bridge painting, bridge repairs, pavement sealing, and rest area maintenance. There is a wide range in the level of contracting for various activities; for example, some agencies contract more than 90 percent of maintenance overlays whereas others contract less than 25 percent. Several agencies use some contracting for more than 15 activities. Seven agencies reported contracting more than 90 percent of six or seven activities. The primary factors considered by the agencies in deciding to contract were availability of personnel, specialized work, specialized equipment, costs, and staff limitations. Contractor availability, peak work loads, agency policy, and responsiveness were also important.

Agency evaluations of maintenance contracting indicated that most believed that contracting was cost-effective, that quality of work was satisfactory, and that contractors were satisfactory or better in responding to emergencies or sudden demands. Several agencies reported having some problems with maintenance contracting. A common problem was the agency procedures for procurement of bids, which some maintenance managers believed were not responsive to their needs—there was difficulty in assembling a contract package, advertising attracted the wrong types of contractor, and the time from advertising to award was too long. Other problems included greater than expected administrative and inspection requirements and some problems with quality, quantity, and scheduling of contractors' work.

In some agencies, the use of contract maintenance is dictated by legal or policy requirements, such as a requirement to contract if expenditures exceed a set threshold. For most agencies the decision process for contract maintenance involves determining whether there is a need to contract and, if so, whether contracting is feasible and desirable. The need for contracting should be based on work load and agencies should consider the annual work program, the resources required, and the availability of those resources. Feasibility determination involves the suitability of the activity for contracting, the capability of the agency to develop and manage the contract, and the availability of contractors. Desirability involves a consideration of agency objectives, management concerns, and anticipated costs.

Once a decision to contract has been made, an agency will need to organize for contract maintenance and then establish a program, define projects, write contract documents (including plans and specifications), advertise and award contracts, and manage the contracts (including inspecting and testing work).

CONTRACT MAINTENANCE

INTRODUCTION

Highway maintenance is vital to the motoring public. There has always been a need for basic maintenance organizations with the trained personnel, equipment, and materials to perform highway maintenance work such as pavement patching, shoulder repair, drainage, mowing, weed and brush control, pavement striping, litter pick up, snow removal, ice control, and repair of bridges. Maintenance organizations have changed over time to respond to the growing maintenance needs of the highway and road and street network. Accomplishing maintenance activities by contract is one of the changes that has occurred.

BACKGROUND

Until the 1970s highway systems in the United States were undergoing development and growth. The emphasis was placed on developing, constructing, and continually improving the highway and road and street networks that are in place today. The maintenance function continually expanded during this period as the networks grew and traffic using the networks continually increased. The objectives of the maintenance function were to provide service to the traveling public and conserve the capital investment in the highways, roads, and streets. The 1970s began a new era in which new highway construction diminished and the emphasis shifted from construction to maintenance. This shift was accompanied by increased operational requirements resulting from demands for greater traffic safety, reduced user costs, and increased service. Consequently, the objectives of the maintenance function have now expanded to accommodate the increased operational requirements and are now considered to include:

- Conserving the investments made in constructing the highway facilities,
- Sustaining adequate levels of service,
- Minimizing the operating costs of users, and
- Enhancing the safety of the traveling public.

In recent years the maintenance function has consumed proportionately larger shares of total public works funding. However, inflation and increasing maintenance needs that result from the aging of the street, road, and highway networks have outpaced these larger funding shares. To accomplish the maximum maintenance program with available funds, maintenance managers have devoted considerable attention to finding new ways to perform maintenance activities at the lowest acceptable cost. This attention has generally been directed toward more effectively managing, standardizing, and improving production processes; defining acceptable lower levels of service; prioritizing the work; and realigning resources. In many cases, decreasing personnel authorizations, personnel policies, union agreements,

and the inability to make timely capital investments in equipment have tended to complicate the acquisition, retention, and allocation of resources. This, in turn, has resulted in less effective accomplishment of the maintenance program. The impact is usually not uniform across the entire maintenance program. Rather, it tends to involve the accomplishment of specific maintenance activities in various geographic areas. To accomplish their maintenance programs under these circumstances, many maintenance managers have been using contracting as an alternative to accomplishing their programs solely with in-house personnel and equipment. Contracting has proved to be an effective alternative in many instances.

PROS AND CONS OF CONTRACTING

The subject of contracting for public services elicits a variety of responses, none of which is neutral. The advantages and disadvantages attributed to the contracting of public services applies also to contracting of maintenance activities. Many government officials tend to view contracting for public services in a positive sense. The contracting industry is an advocate of greater contracting of public services. Public works employees who may lose their jobs or opportunities for advancement because of contracting usually have a very negative view of contracting maintenance activities. The manager responsible for accomplishing the maintenance program generally views contracting in a positive sense but has concerns that may modify the manner in which contracting is used or may require checks and balances to reduce the risks associated with these concerns.

Many elected and appointed government officials cite contracting as a way to improve or increase services, reduce the number of governmental employees and mitigate government personnel and retirement costs, avoid capital investment programs for equipment and facilities, increase the private sector of the local economy and its tax base, and meet social responsibilities by providing opportunities for minority and disadvantaged business enterprises.

Public employees argue against contracting by stating that the function to be contracted is so vital and so much in the public view that it can only be satisfactorily performed by public employees and that only public employees are sufficiently responsive to emergency situations. The cost-effectiveness of contracting is questioned and past examples of corruption in the contract process are offered as further arguments.

Contractors look at performing maintenance work as a logical extension of their capabilities and another market for their services. The opportunity for additional work for the contracting industry is considered beneficial to the local economy. To counter the vital function arguments presented by employee organizations, contractors can and do cite numerous examples of essential public service functions that are being successfully carried out by private organizations. These include solid waste

collection and disposal; water and sewage treatment plant operations; transit management; equipment maintenance; building maintenance; and a variety of highway, road, and street maintenance and operations functions. Cost-effectiveness arguments made by contractors may refute or mitigate the arguments presented by opponents to contracting. These are usually based on the accuracy and adequacy of the cost items included in the cost comparison calculations, higher contractor productivity, and the ability to accomplish very specialized tasks that the maintenance organization may not have the capability to perform at reasonable costs.

The managers of public service agencies often view contracting as a necessary means to accomplish all or part of their responsibilities, provide a less restrictive resource management environment, have flexibility to readily tailor resources to meet changing work loads and budgets, improve performance, and reduce costs. Managers are concerned about the quality of contract work, the ability of contractors to provide emergency response, the long-term cost-effectiveness of the activities contracted, and the provision of services should the contractor default or if bids are excessive.

Most of these points of view and concerns have some validity and may be encountered and should be addressed when considering the implementation or continuation of a contract maintenance program. The corruption issue is not a valid consideration. If the approved agency procurement process is used to award the contracts, there is no reason to expect that contracting for public services and maintenance would have a higher incidence of irregularities than that experienced for other agency contracts.

DEFINITIONS

The term "maintenance" is subject to interpretation. The definitions of maintenance activities used by each maintenance organization are influenced by funding sources, the laws and regulations regarding the use of these funds, the assignment of responsibilities in the overall organizational structure of the agency, and the way the maintenance work is organized and managed. Some agencies may define a particular activity as "maintenance," while others may include the same activity as a "betterment" function. Similarly, the same physical work may be defined by different reporting agencies under separate activity headings. Likewise, some organizations may define bridge, traffic, and signal operations as maintenance while others do not. Some definitions of maintenance encompass all work on a facility that takes place after the original construction, including major rehabilitation and reconstruction. The discussions contained in this synthesis interpret maintenance in a broad context that includes bridge, traffic, and signal operations but excludes major rehabilitation and reconstruction work.

The term "contract maintenance" is also open to various interpretations. Many public agencies have agreements to maintain highway facilities owned by other agencies, such as a city or county maintaining state-owned roads or vice versa, with a corresponding transfer of funding for these services. These functions could strictly be defined as maintenance by contract and are considered by many maintenance managers to be a form of contract maintenance. The interrelationships for these agreements are often complex and vastly different for each type of

government system. In any case, these agreements are in reality intergovernmental transfers of funds to pay for maintenance work that the agency receiving the funds may accomplish either by using in-house resources or by contracting to the private sector. For the purpose of this synthesis, "maintenance by contract" is defined as a highway or public works agency contracting any part of its maintenance responsibilities to individuals or firms in the private sector of the economy.

Excluding intergovernmental maintenance agreements, two basic approaches are used to contract for maintenance services. The first approach is a functional contract that provides for a limited number of specific services in a single contract. The second involves general contracting for a large number of different services in a single contract.

Functional contracts provide for specific types of services for selected sites or sections of highways. The work is usually well defined and the types of personnel skills, equipment, and materials required are limited to the specific service. This type of contract is the most common type of maintenance contract. It is used to accomplish activities such as pavement repair, maintenance overlays, surface treatments, bridge painting, mowing, and other activities of this nature.

General contracts provide for accomplishment of the overall maintenance responsibility on a portion of the network or designated sections of highway. The work is variable, involves many functional activities, and requires the accomplishment of a large number of services with numerous personnel skills, types of material, and equipment. General contracts are currently not widely used by highway maintenance organizations. The Department of Defense, as well as other departments within the federal government, utilize general contracts for maintenance and operation of many of their installations. These contracts usually include the provision of maintenance and operations services for the buildings, utilities, roads, streets, railroads, and airfields located on the installations.

TRENDS

Although public works agencies have historically provided most maintenance functions using in-house resources, the idea of contracting maintenance activities is not new. In August, 1973 the AASHTO Committee on Maintenance published a Maintenance Aid Digest (MAD) No. 4 on the subject of Highway Maintenance by Contract. The data in the Digest indicated that contract maintenance expenditures had increased from 7.2 percent of total maintenance expenditure in 1959 to 14.3 percent by 1972. The same digest also predicted that with maintenance functions expected to increase from 30 percent in 1973 to almost 50 percent of total allocated highway funds by 1985, and with employee ceiling limitations then prevalent, contract maintenance would become an increasingly important part of the highway maintenance program.

The trend of the increasing importance of contract maintenance is undoubtedly valid, but the normal measure of this trend, such as percent of program, dollars expended, contracts in force, activities contracted, and agencies contracting for maintenance, cannot be readily compiled. This occurs because of a lack of historical information and correlatable data from the many agencies using contract maintenance. Positive indicators of this trend, however, include the following.

- MAD No. 24, October 1980 provided information on contract maintenance expenditures for fiscal years 1972 through 1979. The data did not include all states for all years. The overall data that were provided indicated that the contract maintenance expenditures were upward for most states included in the data in terms of either expenditures or percentage of the total maintenance program.

- The *Engineering News-Record* of August 19, 1982 published an article on state highway spending plans for 40 states. The data presented indicated that 21 states were increasing the funds spent on maintenance contracting, five had no change, eight were decreasing funding, and six states did not have entries on maintenance contracting.

- The consensus of the maintenance managers attending the Joint AASHTO Highway Maintenance Subcommittee and TRB Maintenance Management Workshop at Gulf Shores, Alabama, in July, 1984 was that the contracting of maintenance activities would continue to increase.

- A survey for this synthesis conducted by questionnaires sent to all 50 state highway maintenance organizations plus those of Washington, D.C. and Puerto Rico, six Canadian provinces, and a selection of 29 counties, cities, turnpike authorities, and similar agencies concerned with highway maintenance indicated that most of those responding have current experience with contract maintenance as shown in Table 1. Of all respondents, only four (Nevada, Puerto Rico, the City of Miami, Florida, and Washington County, Tennessee) reported having no experience with contracting of maintenance activities. The remaining 71 respondents reported a wide range of experience in contracting maintenance activities from very small trial contracts to states that were contracting many activities. The Texas Department of Highways and Public Transportation reported that it had approximately 1,000 maintenance contracts in effect during 1981-1982.

- Some of the agencies responding to the survey for this synthesis had previously reported in other surveys or forums that they did not contract any maintenance or reported a much more limited list of activities contracted. For example, Indiana in 1971 reported in *Better Roads* that contract maintenance was used for three activities—mowing, resurfacing, and snow and ice removal. In this recent survey Indiana reported using contract maintenance to accomplish all or part of 12 maintenance or operations activities. This growth in the use of contract maintenance is representative of many highway maintenance agencies.

- Legislative mandates have occurred that require trial evaluations of contracting for highway maintenance services. For example, in Iowa, Section 17 of Senate File 561 states the "Feasibility of Contracting with Road Contractors for Highway Maintenance Services should be evaluated." The Iowa Department of Transportation has had an ongoing evaluation program

TABLE 1
AGENCIES CONTRACTING MAINTENANCE

Agency	Total Number of Responses	Number Contracting Some Aspects of Maintenance	Range of Experience: Number of Contract Activities		
			High	Average	Low
States (incl. P.R. & D.C.)	50	48	27	9	0
Canadian provinces	5	5	14	8	4
Local governments	20	18	12	5	0
Total	75	71			

for general maintenance during the past several years, and Iowa DOT has had a successful and expanding program of functional maintenance for many years. The Minnesota legislature has considered a proposal that would mandate using contracts for certain types of improvements through limiting the use of day-labor forces. The Minnesota chapter of the APWA surveyed the 87 Minnesota counties by questionnaire. Of the 56 counties responding to the survey, all were accomplishing some portion of 20 maintenance activities by contract.

- Other indicators are the increasing interest by municipal governments in "privatization" or the contracting for services and the continued emphasis in the federal government to convert commercial or industrial activities that fall under the guidelines contained in OMB Circular A-76 to contract activities. These commercial/industrial activities include most maintenance organizations that provide road and street maintenance to federal installations or reservations. The guidelines provide that commercial and industrial activities should be contracted whenever the costs of conducting the function by the federal government will be reduced through contracting by 10 percent or more.

- Contract maintenance activity in Canada and Great Britain is increasing in a manner similar to that in the United States. In Great Britain, the governmental maintenance organizations must bid against contractors for maintenance work. In Canada, the Ontario Ministry of Transportation and Communications has substantially increased the use of private contractors to provide winter maintenance in the last few years. It is the policy of the Ministry to use contractors where financial analysis and assessment indicate that costs will be reduced.

The trend toward greater use of contracting to accomplish maintenance activities is expected to continue as managers become more experienced in its use and role within their programs.

CURRENT PRACTICES

DATA SOURCES

The primary sources of information on current practices in the use of contract maintenance were a 1983 questionnaire and selected follow-up telephone interviews with various public works agencies as well as a literature search to identify published material on this subject. The literature available amplified and verified information received from the questionnaires.

Section 1 of the questionnaire sent to various public works agencies listed 35 maintenance activities normally carried out by public works forces. It requested respondents to indicate their experience in contracting out each activity. In addition, space was provided for respondents to add other activities contracted out that were not specifically listed. Section 2 addressed decision criteria used by public works agencies in reaching a decision about whether or not to contract maintenance activities. Section 3 elicited information on what economic elements were used in comparative cost analyses (if any), and Section 4 addressed any administrative/legal impediments to contracting maintenance. Section 5 covered contractual methods and organizational control. Section 6 asked for data on any experience of public works agencies in contracting out all maintenance activities for a particular section of highway. Section 7 addressed inspection and control of contract maintenance, and Section 8 requested information on major problems/successes experienced with contract maintenance.

The questionnaire was sent to all 50 state maintenance organizations plus those of Washington, D. C. and Puerto Rico, six Canadian provinces, and a selection of 29 counties, cities, turnpike authorities, and similar agencies concerned with highway maintenance. The response to the questionnaire was excellent. Eighty-seven questionnaires were sent and 75 recipients responded. A summary of respondents and the activities contracted is shown in Appendix A.

At this time there is not a great wealth of literature or studies available on contract maintenance. Some state agencies have produced reports on the subject and some consultants have recently begun to address variable decision parameters involved in the contract maintenance question. Some statistics on contract maintenance expenditures are available from annual surveys undertaken by the trade press, and the American Association of State Highway and Transportation Officials (AASHTO) has published two Maintenance Aid Digests on the subject.

MAINTENANCE ACTIVITIES CONTRACTED BY HIGHWAY AND PUBLIC WORKS AGENCIES

The 35 maintenance activities utilized on the questionnaire were grouped into major maintenance program areas based on functions or highway features. These groupings were:

- Pavements
- Roadside

- Traffic Services
- Bridges
- Drainage
- Other

The maintenance activities within each functional or highway feature group were those that met the broad context defined for maintenance and operations activities to be included in the study and those that would have some uniformity of connotation by all recipients. The activities were chosen after a review of highway, road, and street activity standards used by state, county, and municipal maintenance organizations.

The data provided by respondents indicated that contract maintenance applications exist for activities in each of the major maintenance program areas. The largest application is in the pavement area and the smallest is in drainage. Figure 1 shows the percentage of the total activities listed by the respondents as being contracted that fall within each of these major maintenance program areas for the three categories of respondents—states, Canadian provinces, and cities and counties and the average for all respondents.

Table 2 lists the 35 activities on the questionnaire. Some proportion of each of the 35 activities listed on the questionnaire has been contracted by one or more agencies. In addition, the respondents identified 16 additional activities being contracted. Table 3 lists the additional 16 activities identified by respondents. Because the additional 16 activities were identified by only a small number of respondents it is not known what the response would have been had these 16 activities been included with the original 35 activities. Consequently, the 16 activities are not included in the data presentation on current practices. Of the 35 maintenance activity sets, Table 4 presents the five most frequently contracted activities and the five least frequently contracted activities.

The survey response data indicated that the level of contracting for a particular activity varied widely. Consequently, the responses were grouped to define four contracting levels as follows:

- Most of activity (90% or more contracted)
- Majority of activity (50–89% contracted)
- Significant portions of activity (25–49% contracted)
- Some of activity (1–24% contracted)

The data resulting from the use of the four contracting levels indicate that those activities that parallel the type of work that the construction and service industries perform as a normal course of business are more likely to be contracted in larger proportions than other activities. Based on information available in the literature, these are also the maintenance activities that generally have a longer history of contracting and those for which the agency probably has a greater amount of experience.

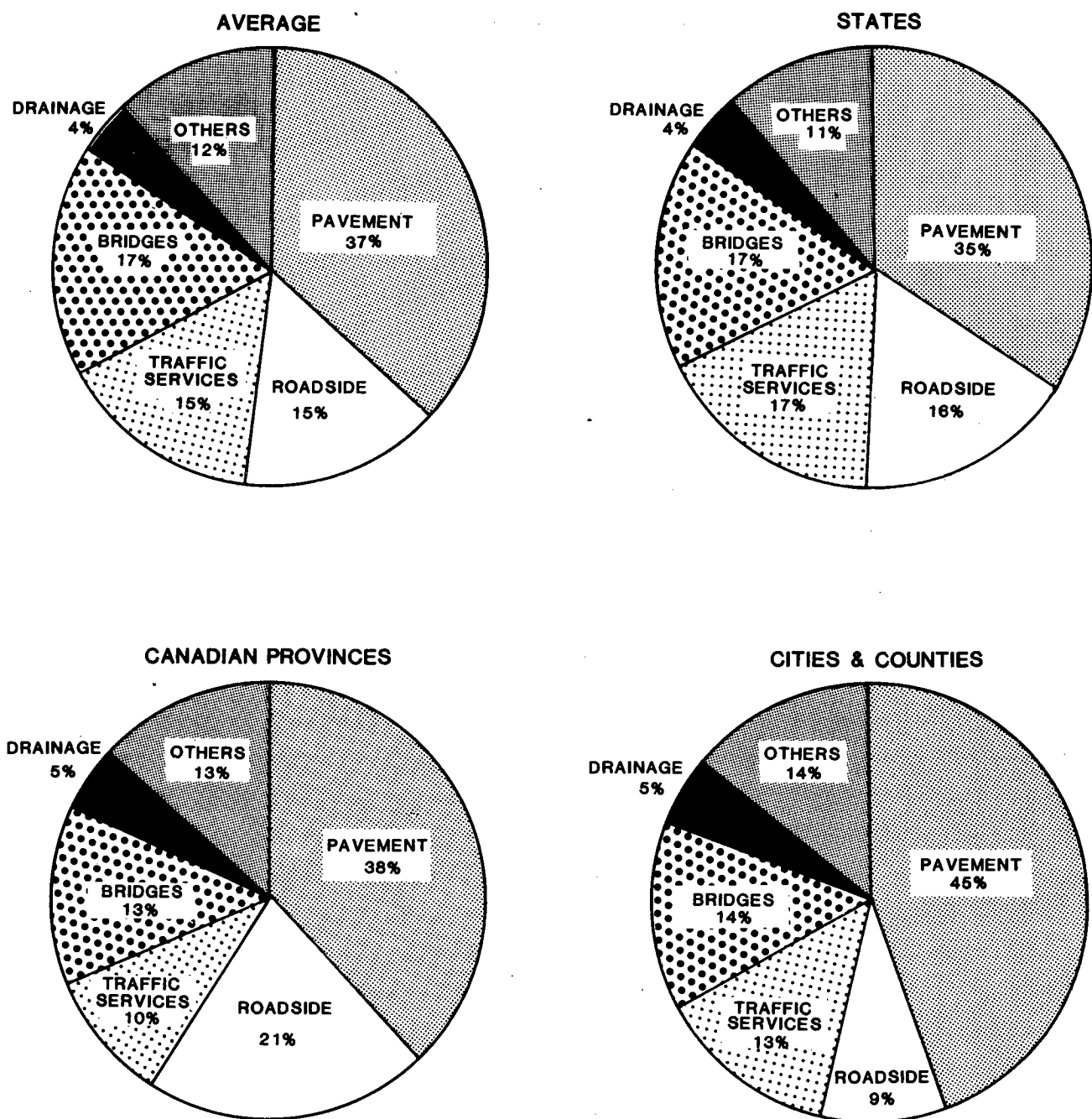


FIGURE 1 Contract maintenance applications (1983).

Many of these activities have characteristics that facilitate their accomplishment by contract. These include:

- Work readily defined as to location, quantities, costs, and required time of accomplishment.
- Can be packaged into a distinct project.
- Ease of inspection and control.
- Experienced and capable contractors available.

These activities are usually contracted using the functional contract approach.

Housekeeping and routine maintenance activities are not currently contracted at high levels. These activities are more difficult to define in terms of location, quantities, and time when service is needed. They are more difficult to place into a contract package that is attractive to contractors and may require more inspection and control than is readily available to the maintenance organization because of the variable nature of these activities.

It is probably more appropriate to include housekeeping and routine activities in a general contract than to attempt to use a functional-type contract. In using the general contract approach

TABLE 2
THIRTY-FIVE MAINTENANCE ACTIVITIES LISTED ON
QUESTIONNAIRE

PAVEMENTS	TRAFFIC SERVICES
Pavement Sealing	Signal Maintenance
Maintenance Overlay	Lighting Maintenance
Patching and Repair	Pavement Striping (centerline)
Temporary Repair	Pavement Marking (symbols)
Joint Repair	Sign Repair
Crack Sealing	Sign Cleaning
Slab Jacking and Undersealing	
Shoulder Maintenance	ROADSIDES
Sidewalk Repair	Rest Area Maintenance
Emergency Repair	Mowing
Heater Planing and	Chemical Application
Scarification	Litter Control
	Unpaved Shoulders
	Seeding and Mulching
BRIDGES	OTHER
Bridge Operations	Sand or Deicing Chemical
Bridge Painting	Application
Bridge Repair	Snow and Ice Removal
	Guardrail Removal
DRAINAGE	Attenuator Repair
Culvert Cleaning	Material Supply
Sewer Cleaning	Management Activities
Roadside and Outfall Ditches	

a sufficient volume of work can be packaged into one contract so that contractor interest will be sufficient to procure competitive bidding.

Table 5 provides the number and percentage of agencies contracting for an activity at each of the defined contracting levels.

AGENCIES USING CONTRACT MAINTENANCE

Only four agencies of the 75 respondents reported using no contract maintenance for any of the 35 activities listed in the questionnaire, and three agencies reported contracting only one activity.

Tables 6 and 7 list the agencies contracting the most and least number of the 35 activities. The ranking of agencies contracting large proportions of activities is given in Table 8. This table depicts those agencies reporting the largest number of activities contracted out, 90 percent or greater. A further indication of the amounts of work contracted as a proportion of total maintenance items may be obtained by simply adding the percentages of contract maintenance reported by each agency. Thus, an agency that contracted 100 percent of all 35 activities listed on the questionnaire would score 3,500, and an agency that reported contracting 100 percent of two activities and 20 percent of three other activities would score $(2 \times 100) + (3 \times 20) = 260$. Using this concept the scores of all respondents have been computed and displayed in Figure 2 as a percentage above or below the average score for all respondents.

FACTORS USED IN DECIDING TO CONTRACT FOR MAINTENANCE ACTIVITIES

The second section of the questionnaire listed nine factors for consideration that may influence the decision process used by agencies in deciding whether or not to contract maintenance

activities. Space for agencies to delineate any other considerations employed in the decision process was provided. Table 9 summarizes the results.

Three agencies provided additional factors used in their decision process. Delaware added "Emergencies." Wyoming added "Quality of Work." Seattle added "Labor Relations." Each of these is a valid consideration and is probably taken into account, directly or indirectly, by most other agencies. Emergency considerations will occasionally occur, quality of work is an important consideration and is probably used to define the "availability of contractor" criteria, and labor relations is undoubtedly incorporated into the "agency policy" by many jurisdictions.

In general, most agencies used the majority of the consideration factors in their decision processes. It was anticipated that costs would be a consideration used by every agency as a prime or overriding factor. An unexpected result of the questionnaire was that several agencies reported that costs were not a primary decision factor in contracting maintenance activities. Discounting the four agencies that did not contract out any maintenance activities, and therefore did not complete this section of the questionnaire, the following states reported that costs were not a primary factor in their decision process: Alabama, Missouri, Colorado, New Mexico, Delaware, Pennsylvania, District of Columbia, and Idaho.

On further investigation, it was found that there are situations where costs are discounted as a prime factor in the decision process. These situations include the following.

- Agency cannot perform work with own forces, knows what range of costs are reasonable for the activity, and is using a competitive bidding process.
- Agency does not maintain capability to perform specialized work and is using a competitive bidding process to obtain contractor services.
- Emergency situation where response is needed immediately and becomes overriding in the decision process.
- Agency does not know own costs and cannot make the proper comparisons to use in the decision process.

Contracting for maintenance activities sometimes is used by agencies to allow them to get work accomplished while remaining within prescribed personnel ceilings. The factors concerning the availability of personnel and staff limitations may have been ambiguous and the results indicated some overlapping interpretations by respondents. The staff limitation factor was intended as a means to differentiate between those cases where in-house personnel were simply not available at the proper time to do the work and those instances where overall personnel ceilings had been set by legislative and administrative authorities that severely limited the ability to staff adequately. The overall effect with respect to contracting for maintenance is the same. The needed work is contracted because personnel are not available. Lack of required personnel is the primary reason reported for contracting maintenance work.

Many agencies have found it effective to contract for maintenance work that requires special skills and equipment. Welding of structural members on bridges is an example of such an activity. Maintaining the certified welding personnel, the welding equipment, and the variety of materials required is not considered cost-effective if the volume of work is low and occurs

TABLE 3
SIXTEEN ADDITIONAL CONTRACT MAINTENANCE ACTIVITIES CONTRACTED

Agency	Activity															
	Milling/Planing/ Grinding/Sawing	Road Sweeping	Brush Removal/ Tree Trimming	Trash Collection	Landscaping/ Fencing	Major Slides	Telephone/Emergency Call System	Temporary Traffic Signals	Jersey Barriers	Bridge Deck Overlay/ Sealing/Expansion Devices	Piles/Fenders/ Erosion Control	Bridge Railing Repair	Bridge Electrical and Mechanical Repair	Tunnel Cleaning	Culvert Replacement	Sideline Pipe/ Ditches/Channel
Alabama																
Alaska																
Arkansas			<input checked="" type="checkbox"/>													
Delaware			<input checked="" type="checkbox"/>													
Florida		<input type="checkbox"/>														
Idaho		<input type="checkbox"/>													<input type="checkbox"/>	
Illinois		<input checked="" type="checkbox"/>	<input type="checkbox"/>													
Indiana																
Kentucky																
Louisiana																
Maine																
Massachusetts																
Michigan		<input type="checkbox"/>														
Missouri																
New Jersey																
New Mexico	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>														
Ohio	<input checked="" type="checkbox"/>															
Oklahoma	<input checked="" type="checkbox"/>															
Oregon	<input checked="" type="checkbox"/>	<input type="checkbox"/>														
South Carolina																
South Dakota																
Utah																
Washington				<input type="checkbox"/>												
Wyoming																
Ontario																
Madison, Wis.	<input checked="" type="checkbox"/>															
Baltimore Co., Md.			<input type="checkbox"/>													
Oakland Co., Mich.																

- 90% or greater of activity contracted
- 50% to 89% of activity contracted
- 25% to 49% of activity contracted
- 1% to 24% of activity contracted

TABLE 4
MOST FREQUENTLY AND LEAST FREQUENTLY
CONTRACTED ACTIVITIES (1983)

Activity	Respondents	
	%	No.
Most Frequent		
Maintenance overlays	77	58
Bridge painting	67	50
Bridge repair	55	41
Pavement sealing	43	32
Rest area maintenance	35	26
Least Frequent		
Seeding and mulching	7	5
Unpaved shoulder	4	3
Attenuator repair	4	3
Sign cleaning	3	2
Management functions	1	1

intermittently. In cases such as this it is far better to contract the work than maintain the capability to perform the activity.

In this regard the agency should have an established policy concerning contracting for maintenance work. Approximately a third of the respondents did not report agency policy as being a primary decision factor. Some agencies obviously have a policy or practice of not contracting any maintenance activity, others have policies on contracting certain activities, and others consider contracting all activities where it is cost-effective to do so. An established policy is important in that it can provide guidance to accomplishment of the overall maintenance program. For example, since 1979 Boulder, Colorado has been involved in upgrading its street maintenance program. Based on an analysis of costs, skills, and equipment to do maintenance activities, the city has chosen to accomplish some maintenance activities with in-house personnel, do some maintenance work using a combination of in-house personnel and contract forces, and to accomplish other maintenance activities exclusively by contract. The program, based on the policies established from the analysis, has resulted in a more systematic maintenance program, the reduction of permanent staff, and an improved condition of the city's streets.

Over half of the agencies responding used peak work loads and responsiveness in their deliberations. Because much maintenance work is seasonal in nature, it leads to peak work loads during certain periods of the winter and summer months. Many agencies cannot and probably should not staff to accommodate these peak periods. Consideration of the peak work-load requirements, the response needed to accomplish the work in the limited time available, and the availability of personnel for the peak period may be the combination of prime factors currently used in the decision-making process as to whether or not the work should be contracted.

Contractor availability should be an important consideration. If contractors are not available to perform, are not equipped, or simply are not interested in the contemplated contract work then the agency has no choice but to forego the required services or provide it with in-house resources. The evaluation of contractor availability includes determinations concerning:

- Sufficient contractors available with any specialized skills or equipment needed.
- Sufficient contractors available within the geographic area of the work.
- Sufficient contractors available with adequate track records of quality work and responsiveness.
- Adequate numbers of suitable contractors available who are interested, will bid on the work, and provide competitive bids.

Some agencies have had to develop a base of contractors who can perform maintenance contracting. The development has been accomplished by instituting the contracting process slowly on a test basis. The scope is initially small, and equipment requirements usually are modest. As the contractors gain experience with the work, the scope is increased and over time some very capable contractors have developed. In many cases agencies have found that small contractors have a more competitive cost structure for maintenance work than large contractors and their small size makes them well suited for accomplishing the type of work required for many maintenance activities.

Agencies have also expended extraordinary efforts to interest contractors in maintenance work. They have asked for contractor input in developing the contracts and have held conferences to explain the work so that contractors will understand what is to be done, the standards to be applied, and how the work should be managed. In this manner the contractors have become more interested and informed concerning accomplishing maintenance activities by contract. This has resulted in more competitive bidding and better contract performance.

COST COMPARISON FACTORS

The third section of the questionnaire requested information on what factors an agency uses to calculate its own in-house costs when evaluating costs as a decision criteria in the contract maintenance choice.

The questionnaire listed nine factors or types of costs that might be included by an agency in a cost comparison situation. Material costs were not listed. Although material costs may be significant and will normally be part of the cost comparison, the quantity, quality, and costs of materials for a maintenance activity should be essentially equal for the contractor and the agency. In those cases where the agency has materials on hand or is able to procure materials more economically than the contractor, it is a common practice for the agency to furnish the materials to be used in the contract. Consequently, in the majority of cases material costs should not affect the results of the cost comparison. Any additional costs incurred by the agency for procurement, storage, handling, and control resulting from the agency providing the materials would normally be included in the cost comparison.

Table 10 gives the cost comparison factors used by the 57 agencies that responded to this section of the questionnaire. The majority of all agencies used the first four factors in their cost analyses. The remaining five factors were used only by one-third to about half of the respondents. Only eight agencies

TABLE 5
CONTRACTING LEVELS

Activity	90% Contracted		50-89% Contracted		25-49% Contracted		1-24% Contracted		Program Levels Not Furnished	
	No.	%	No.	%	No.	%	No.	%	No.	%
Pavements										
Pavement sealing	12	16	5	7	6	8	6	8	3	4
Maintenance overlays	29	39	10	13	4	5	11	15	3	4
Patching and repair	2	3	5	7	2	3	10	13	1	1
Temporary repair	0	0	2	3	0	0	3	4	2	3
Joint repair	5	7	1	1	1	1	3	4	0	0
Crack sealing	4	5	5	7	1	1	3	4	0	0
Slab jacking	10	13	1	1	0	0	1	1	0	0
Shoulder maintenance	0	0	2	3	2	3	6	8	0	0
Sidewalk repair	6	8	4	5	0	0	2	3	0	0
Emergency repair	0	0	5	7	2	3	3	4	0	0
Heater planing	15	20	2	3	0	0	1	1	0	0
Roadsides										
Rest area maintenance	1	1	3	4	5	7	14	19	3	4
Mowing	1	1	4	5	2	3	12	16	2	3
Chemical application	2	3	7	9	5	7	7	9	1	1
Litter control	0	0	0	0	3	5	6	8	0	0
Unpaved shoulder	0	0	0	0	0	0	3	4	1	1
Seeding and mulching	0	0	2	3	0	0	2	3	0	0
Traffic Services										
Signal maintenance	3	4	1	1	2	3	7	9	1	1
Lighting maintenance	7	9	4	5	2	3	5	7	1	1
Pavement striping	2	3	2	3	3	4	14	19	2	3
Pavement marking	2	3	0	0	0	0	6	8	0	0
Sign repair	0	0	0	0	1	1	7	9	0	0
Sign cleaning	1	1	1	1	0	0	0	0	0	0
Bridges and Tunnels										
Operations	0	0	0	0	0	0	3	4	0	0
Painting	30	40	9	12	2	3	6	8	2	3
Repair	5	7	15	20	4	5	8	11	3	4
Drainage										
Culvert cleaning	1	1	0	0	0	0	7	9	0	0
Sewer cleaning	2	3	1	1	0	0	4	5	0	0
Ditches	0	0	0	0	0	0	7	9	1	1
Other										
Sand and deicing	0	0	1	1	1	1	2	3	1	1
Snow and ice removal	0	0	2	3	3	4	11	15	1	1
Guardrail removal	1	1	7	9	1	1	6	8	1	1
Attenuator repair	0	0	2	3	0	0	0	0	0	0
Material supply	15	20	2	3	0	0	2	3	2	3
Management activities	0	0	0	0	0	0	1	1	0	0

reported using all nine factors in their calculation of agency costs. These were:

Colorado
Nebraska
Wyoming
Puerto Rico
Nova Scotia
City of Portland, Oregon
Montgomery County, Maryland
Wayne County, Michigan

Because Puerto Rico reported that it does not contract any maintenance, only seven agencies in the survey use all nine factors in calculation of agency costs for comparisons used in the contract versus in-house maintenance decision.

A typical maintenance organization may exhibit cost proportions in the range shown in Table 11. Therefore, agencies that do not include for the last five items in their cost estimates used for comparisons with contractor costs could theoretically be significantly underestimating their true costs.

The equipment rental rates used by many agencies for agency-owned equipment are developed using both direct and indirect

TABLE 6
AGENCIES CONTRACTING THE GREATEST NUMBER OF
ACTIVITIES

Agency	Number of Activities Contracted (of 35 on questionnaire)
Massachusetts	27
Pennsylvania	23
Texas	20
Ohio	18
Kansas	16

costs. Consequently, the rates used by these agencies would reflect the last five items. A small but growing number of agencies also include a replacement charge in their rental rates to accommodate the difference between accumulated depreciation charges and replacement costs for items of equipment.

Many agencies have considered the use of the last five items in cost comparisons and concluded that some or all of these costs have been included in other cost items or will not be materially affected one way or the other by the agency's contract maintenance activities. Based on that conclusion one or more of the items will be excluded from the compilation of agency costs used to make comparisons.

The primary requirement in a cost comparison is to compare equivalent costs for doing the work with in-house forces and contract forces. The comparison should be reasonable and provide the decision maker with information on which to judge the relative cost-effectiveness of alternatives available. A method of equitable cost comparison is described in Chapter 3.

The federal government has a prescribed method of making cost comparisons for contracting decisions concerning its commercial and industrial activities. Supplement 1 to OMB Circular A-76 "Cost Comparison Handbook" provides detailed instructions concerning the method and developing the necessary cost comparison.

TABLE 7
AGENCIES CONTRACTING THE LEAST NUMBER OF
ACTIVITIES

Agency	Number of Activities Contracted (of 35 on questionnaire)
Nevada	None
Puerto Rico	None
Miami, Florida	None
Washington County, Tennessee	None
Raleigh, North Carolina	1
Hennepin County, Minnesota	1
Wayne County, Michigan	1

ADMINISTRATIVE OR LEGAL IMPEDIMENTS

Section 4 of the questionnaire asked "What legal or administrative restrictions to the use of contract maintenance exist in your agency?" No respondents identified any legal impediments with respect to the agency's ability to use contract maintenance. Several agencies indicated that the manner in which their budgets are structured and approved administratively limits their ability to undertake contract maintenance. Several agencies also commented that certain administrative requirements may inhibit the contracting process.

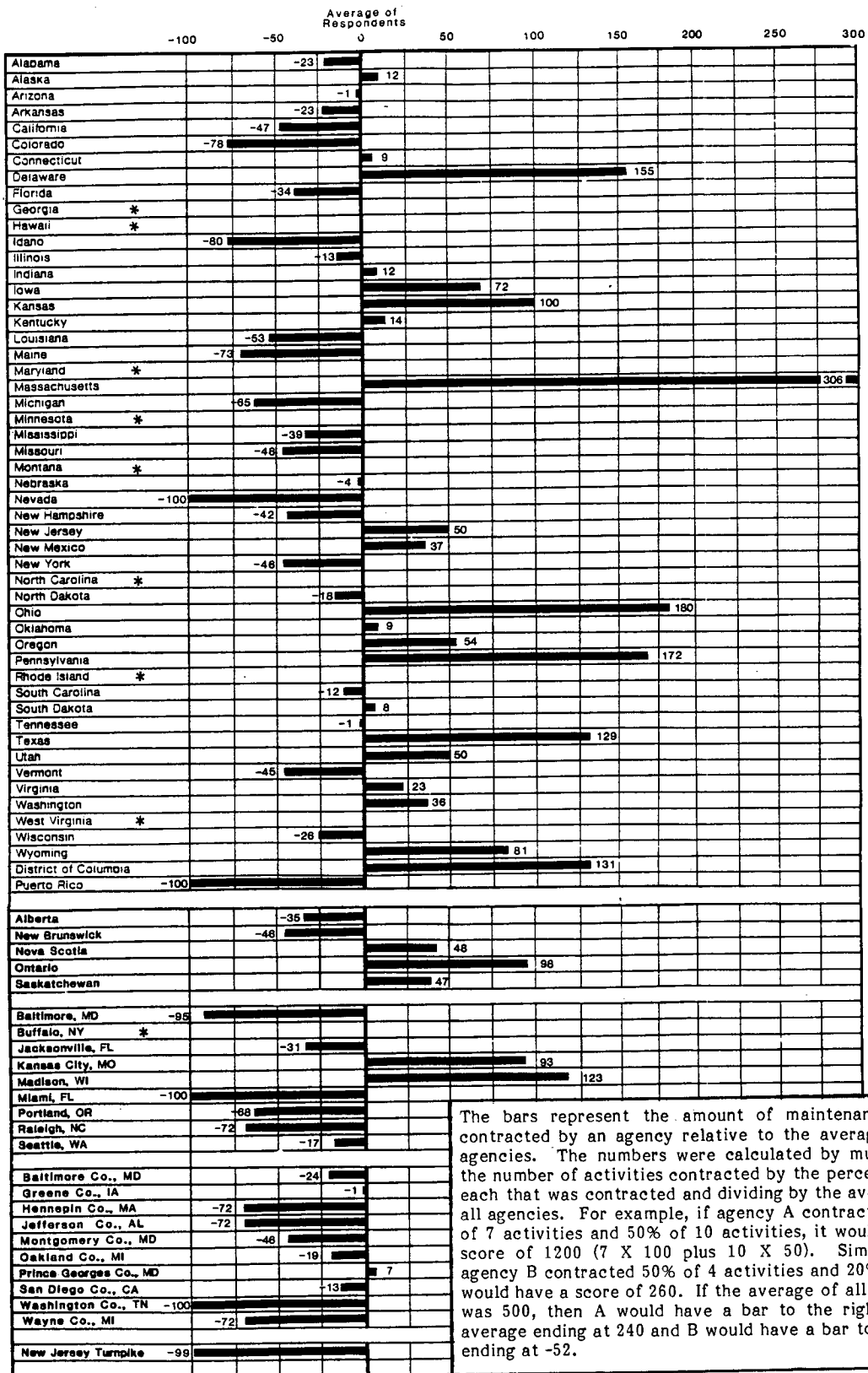
Bonding requirements may be routinely required by the agency's contracting regulations or by law. For many maintenance contracts the performance requirements are such that the work is very suitable for small contractors who may not have or cannot obtain suitable bonding to meet the agency's bonding requirements. A bonding requirement may prevent otherwise qualified contractors from bidding and may well exclude the majority of minority and disadvantaged firms (for whom bonding is a continuing and expensive problem) from competing for maintenance contracts. The inclusion of bonding requirements in a contract for maintenance activities should be carefully considered by the agency.

The agency's administrative procedures as to payment of contractor invoices may well reduce the interest of contractors in performing maintenance work. Small contractors usually do not have the financial assets to wait long periods for payment of their invoices. They need to be paid as the work progresses or immediately on completion. If the agency procedures will not provide sufficient cash flow to the contractor then the contractor may not be interested in bidding. If awarded a contract he or she may not be in a financial position to handle the negative cash flow until payment and is not able to carry the work to completion and is forced to default. The agency should ensure that the payment procedures included in the contract do not hinder the achievement of the objectives for which the contracting was undertaken.

Tort liability may prove to be an additional impediment to contracting for maintenance. In states where sovereign immunity has been lost, the states have attempted to limit their exposure to tort liability claims by including hold harmless or indemnification clauses in their contracts. For example, Pennsylvania, which has a large contract maintenance program and

TABLE 8
AGENCY RANKING FOR CONTRACTING WORK

Agency	Number of Activities Contracted at More than 90% of Activity
Delaware	7
District of Columbia	7
Kansas City, Missouri	7
Massachusetts	6
Pennsylvania	6
Wyoming	5
Madison, Wisconsin	5



The bars represent the amount of maintenance work contracted by an agency relative to the average of all agencies. The numbers were calculated by multiplying the number of activities contracted by the percentage of each that was contracted and dividing by the average for all agencies. For example, if agency A contracted 100% of 7 activities and 50% of 10 activities, it would have a score of 1200 (7 X 100 plus 10 X 50). Similarly, if agency B contracted 50% of 4 activities and 20% of 3, it would have a score of 260. If the average of all agencies was 500, then A would have a bar to the right of the average ending at 240 and B would have a bar to the left ending at -52.

* Percentages Not Provided

FIGURE 2 Relative amount of maintenance work contracted.

TABLE 9
FACTORS CONSIDERED IN DECISION PROCESS

Factor	% Using
Availability of personnel	91
Specialized work	89
Specialized equipment	89
Costs	89
Staff limitations	77
Availability of contractors	67
Peak workloads	67
Agency policy	62
Responsiveness	56
Other: Emergency	1.5
Quality of work	1.5
Labor relations	1.5

no sovereign immunity, requires that an indemnification provision be included in all contracts between the Commonwealth and private contractors or municipalities. This clause reads:

The Commonwealth shall not be liable, nor shall it indemnify, defend, or save harmless the _____ for the negligent acts of employees of the _____ during the performance of, or resulting from the performance under this agreement.

This in effect forces contractors into an additional insurance program that they must maintain to ensure against the risk of being included in or being forced to defend a suit against the Commonwealth at any time during the contract and *after the work is completed*. Many contractors, and especially small contractors, cannot afford the insurance premiums or accept the long-term risks from exposure to tort liability suits against a

TABLE 10
COST COMPARISON FACTORS

Factor	Number of Agencies Using this Factor	% of the 57 Respondents
Direct labor	57	100
Equipment rental	54	95
Fringe benefits	51	89
FICA and retirement	50	88
Office and shop rental	30	53
Utilities	29	51
Insurance (equipment, etc.)	23	40
Depreciation of capital assets	21	37
Support services	20	35

government agency. The suit might include them as codefendants with the agency or, based on the specific indemnification clauses in the contract, may name the contractor as the primary defendant.

TYPES OF CONTRACTS USED

Section 5 of the questionnaire requested information on types of maintenance contracts utilized. More than 87 percent of the agencies responding positively used a unit-price format. Thirty-nine of 71 respondents used lump-sum contracts in addition to the unit-price method, and 11 agencies used cost-plus reimbursement formats. There was no consistent practice with respect to the type of contract and any specific maintenance activity contracted. Each contract is apparently developed on the specific requirements of the work. No respondent expressed any particular problems associated with the type of contract used by its agency to contract maintenance activities.

CONTRACTING APPROACH USED

Section 6 asked if agencies had any experience in contracting all routine maintenance on a route or section of the road network. There were no responses to this inquiry, leading to the conclusion that existing maintenance contracts tend to be on an activity or functional basis. Iowa has recently conducted an experiment using the general contract approach for maintaining sections of its highway network, but its experience was such that it has abandoned the effort.

CONTRACT ADMINISTRATION

Section 7 of the questionnaire addressed the administration and inspection of maintenance contracts. The results are provided in Table 12. The majority of the administration of contracts for maintenance activities occurs in the construction and maintenance organizations.

Some organizations reported that they will administer contracts through one or more organizational elements depending

TABLE 11
AGENCY COST PROPORTIONS

Factor	Approximate Range of Proportional Cost (excluding materials)
Direct labor	35% - 50%
Fringe benefits	7% - 15%
FICA and retirement	7% - 15%
Equipment rental	10% - 20%
Office and shop rental	2% - 5%
Utilities	0% - 1%
Insurance	0% - 1%
Support services	2% - 5%
Depreciation of capital assets	10% - 15%

TABLE 12
ORGANIZATION ELEMENTS PROVIDING CONTRACT ADMINISTRATION

Type of Contract	Number of Agencies Using	Organization Being Used for Contract Administration						
		Constr.	Maint.	Engr.	PW	Admin.	Purch.	Not Reported
Unit price	62	24	34	3	1	1	-	6
Lump sum	39	12	24	2	-	-	-	3
Cost plus fixed fee	11	7	6	1	-	-	-	1
Hourly (equipment)	5	1	5	-	-	-	-	-
Other than above	5	-	4	1	-	-	1	-

on the type of contract, activity contracted, scope of the effort, and funding source. The number of organizational elements in Table 12 providing contract administration exceeds the number of agencies using a particular type of contract because of this multiple administrative arrangement.

AGENCY'S EVALUATION OF CONTRACTING MAINTENANCE ACTIVITIES

Section 8 of the questionnaire asked respondents to provide information concerning their experience with contract maintenance. Of particular interest was information concerning cost-effectiveness, quality and quantity of contractor work, benefits to the agency, responsiveness of contractors, overall success, specific success items, and problems that had been encountered. Fifty-two of the 71 respondents provided comments and information on these items.

Cost-Effectiveness

Twenty-seven agencies provided information concerning cost-effectiveness. Sixteen stated that contracting for maintenance activities was cost-effective, three stated that the cost-effectiveness varied depending on the activity contracted, one was not sure, four stated that contracting was not cost-effective, and three did not consider the cost-effectiveness of their contracted maintenance activities.

Typical comments included:

With respect to cost-effectiveness, this is the primary reason a given maintenance procedure will be contracted. Whenever possible, we perform our routine maintenance unless a contractor can consistently do the job at a lesser rate. (Department of Public Works, County of San Diego, California)

Intense competitive bidding is quite evident in our State in recent years, which has resulted in lower bids which has promoted cost-effectiveness. (Wyoming Highway Department)

We believe contract maintenance has been very cost-effective. (Virginia Department of Highways and Transportation)

Some projects have proven to be cost-effective, others have not. Making the determination is difficult. (Florida Department of Transportation)

... no estimate of the cost-effectiveness. ... A small study of limited scope is underway to try to determine whether or not contract maintenance is, in fact, cost-effective. (Pennsylvania Department of Transportation)

In reference to cost-effectiveness, we find that most of the time we can do the work cheaper with our own state forces. (South Dakota Department of Transportation)

... costs are higher. (Missouri Highway and Transportation Commission)

Cost-effectiveness—On most of these contracts we really do not consider if we could do it in-house cheaper. If the work requires special equipment that we do not have—we go to contract. Weather and staffing pretty well determine the method. (New Mexico Highway Department)

... cost-effectiveness often can not be considered because of staff limitations which force contract work regardless of cost-effectiveness. (Louisiana Department of Transportation and Development)

Quality and Quantity

Twenty-eight agencies provided information on the quality and quantity of the work performed by contractors. The responses ranged from being happy with the results to stating that the work was done poorly. Sixteen respondents indicated that the quality of contract work was good; two thought the work was as good as that produced by in-house forces; two respondents indicated that the work had improved over time; and one thought the work had gotten worse. Seven reported that the quality was less than expected.

Typical comments were as follows:

In general ... quality of work ... and quantity of work has been good. (Wyoming Highway Department)

The Department has realized an increase in quantity and quality. ... (Pennsylvania Department of Transportation)

Responsiveness and quality have been satisfactory, quantity is limited by budget. ... (Louisiana Department of Transportation)

Quality of work is comparable to regular maintenance work. (California Department of Transportation)

The quality and quantity of work have improved since contract maintenance began. (Mississippi State Highway Department)

... We have noted in multi year contracts ... that service declined in the second and third year of the contracts, leading us to discontinue letting mowing contracts. First time ... maintenance contracts let on a local basis have proven satisfactory. However, because of stiff competition, second time letting bid prices have been unrealistic and work has sometimes been unsatisfactory, requiring a reletting of work. (Michigan Department of Transportation)

... there have been some occasions where the "low bidder" has not provided the quality of work ... desired. (New Jersey Turnpike Authority)

Benefits

Only a few of the responses provided information on the benefits that have been gained from contracting maintenance work. Those that did provided the following list of benefits:

- More work is done at a lower cost.
- Greater success at meeting schedules.
- Ability to reassign personnel to other work.
- Ability to accomplish maintenance work that would not otherwise be performed.
 - Production advantages from using specialized equipment and labor.
 - Elimination of the need to purchase and maintain specialized equipment that has limited use.
 - Enhances uniformity of levels of service between agency's geographic jurisdictions.
 - Innovative techniques have been developed by contractors to perform some activities.

Ohio had a benefit that was unusual. Ohio DOT maintenance crews are limited by law as to the total cost of in-house effort that can be expended on various highway features. Contracting allowed the Department to accomplish the work that was in excess of these limits.

Responsiveness of Contractors

The responses to this portion of question 8 involved the timeliness of the contractor to respond to an emergency or sudden demand and the satisfaction to which the contract work was carried out. With respect to timeliness several respondents gave their comments on the ability of contractors to respond in a short time frame. One such comment was:

We have had the most success with contracts for specific work activities. We believe that responsiveness is a problem when contracts are for maintenance of all highways in a geographic area. (Illinois Department of Transportation)

The State of Washington had an almost identical comment about contractor responsiveness. A number of respondents also commented favorably on the responsiveness of the contractor when only equipment and labor were being supplied to assist in-house forces.

Twenty-seven respondents provided their comments concerning contractors being responsive to the contract requirements. Agencies provided information ranging from highly favorable to having major problems with the work that was performed.

The percentage distribution of the responses is provided in Figure 3. Of the 27 agencies providing comments, 2 were highly favorable, 13 favorable, 6 satisfied, 5 reported experiencing a few problems, and 1 had major problems (which were not described).

Problems Encountered

Twenty-eight questionnaires had some reference to one or more problems encountered during the contracting of the maintenance work. A number of the agencies that were pleased with the overall responsiveness of the contractor still had problems in the actual execution of the work. The problems involved four major topics: contract documents, procurement, contract administration, and the contractor's performance.

Contract Document Problems

The problems identified concerned the inadequacy of specifications used by the agency for some activities and incompleteness or lack of procedures to handle situations involving default of the contract by the contractor. Only two agencies reported having specification problems but did not elaborate on the specific problems encountered. The default by a contractor can be very disruptive to the overall work effort because agencies have used contract maintenance as a means to supplement their in-house work. It must be recognized that contractors go in and out of business and sometimes they do not complete their contracts. The risk of not being able to provide the contracted services until a new contractor is acquired must be recognized. A default situation must be anticipated both in the contract documents and in the agency's work plan; appropriate procedures must be developed to overcome any impacts.

Procurement Problems

The approved procurement procedures of an agency usually prescribe the contents of a contract package, the method of advertising for bids, and the minimum time for contractors to prepare bids. Several agencies stated that this caused them problems. The process was not responsive to their needs in that it was difficult to assemble the contract package (which was felt in some cases to be much more elaborate than needed), the advertising sometimes attracted the wrong type of contractor, and the time from advertising to contract award date did not meet their work schedule needs. Some comments were received concerning the requirement to award to the low bidder. In some cases the competition for maintenance contracts was intense or the bidders were not fully cognizant of the cost of the work; thus the low bid received was below the cost of doing the work. Yet, the contract was required to be awarded to the low bidder. Contractor performance in these reported contract situations was not satisfactory. There is always the opposite risk of a contractor "buying in" or low balling a bid to get the contract. The agency may, over time, find itself dependent on the contractor to such an extent that the contractor or contracting industry raises its prices. At that point the contracted services may cost more than similar services may have cost had they

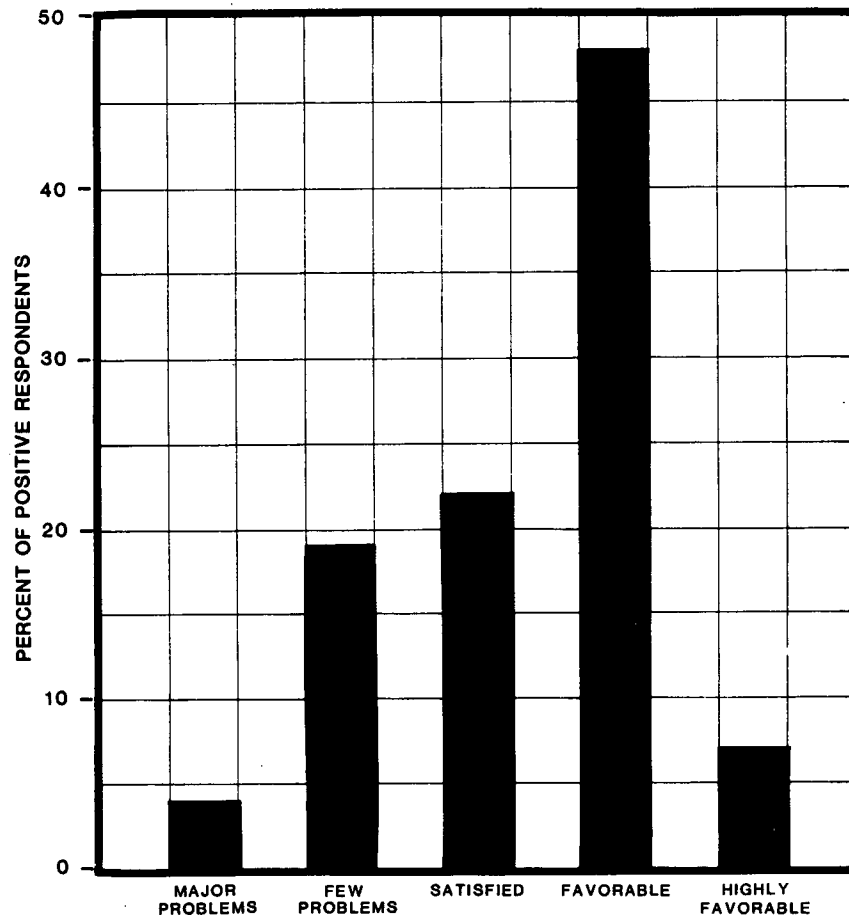


FIGURE 3 Levels of satisfaction with contract maintenance.

been accomplished with an in-house operation. One agency is currently evaluating a situation where prices on activities that are essentially 100 percent contracted have been increasing at a rate in excess of that experienced on other contracts.

Contract Administration

Several agencies commented that the amount of paper work involved and the inspection and monitoring requirements were usually greater than they initially anticipated. This was considered more of a problem when maintenance crew personnel were performing the administrative and inspection functions in addition to their other duties. Their background and training were usually not conducive to accomplishing the function as effectively as trained contract administration personnel.

Contractor Performance Problems

In addition to comments concerning quality of work previously mentioned, the performance comments centered around the profit motivation of the contractors; the tendency of contractors to spread themselves too thin and not execute the work

aggressively during periods when the contractor has a lot of work; and the difficulty in coordinating and scheduling the contractor's work with other contract work or that of agency crews. Contractors are in business to make a profit and that motivation is sometimes difficult for governmental agency personnel, whose motivation centers on service, to appreciate. Unless they are compensated, contractors have a clear right not to do work beyond the scope of their contract or not to perform work to higher quality standards than those specified. It is often difficult to design a contract document that can cover all possible circumstances. The contractor's refusal to do extra work, respond quickly, and increase quality beyond that required in the contract without additional compensation is often viewed by agency personnel in a negative sense. This same motivation may sometimes cause the contractor to view the total work in the context of profit and to have a tendency to prioritize work efforts in terms of potential profits. If the contract maintenance work is low profit and contract requirements are not definite as to the manner the work is to be accomplished, then the contractor may well choose to do the work in a manner not expected by the agency. This fact should be recognized when developing the requirements placed into the contract so that the work will be executed by the contractor in accordance with the contracting agency desires.

Successful Practices

The use of retired persons or associations and organizations of retired persons for contract maintenance of rest areas was a practice that received only favorable comments from those employing the practice. Many older persons desire to supplement their income or keep active for health reasons. Contracting maintenance of rest areas to these persons or groups has been beneficial to the agency in that it has helped give the rest areas

the attention they deserve at a reasonable cost. One contract maintenance contractor for rest area maintenance used by both Minnesota and New York is that of the Green Thumb organization. The Green Thumb is a non-profit organization of persons 60 years of age or older whose annual incomes do not exceed a specified maximum amount. The Green Thumb's contract performance for these two states has been very satisfactory. Other agencies have contracted directly with older individuals and have had similar experiences.

DECIDING TO CONTRACT

INTRODUCTION

The contracting of maintenance involves two basic but different sets of decisions. The first set is concerned with the determination of whether or not to contract. There are situations where the contracting of certain maintenance activities is required by law, directive, or policy. At the other end of the potential contracting spectrum there are situations for which contracting is clearly not appropriate. Between these extremes the maintenance manager has the option of contracting or performing the work with agency resources and must make the decision whether or not to contract.

The second set of decisions involves the implementation of the decision to contract. The contracting of maintenance activities should be nondisruptive to the agency and its operations. Contracting should not be implemented unless the agency is prepared and organized to initiate and undertake the contemplated contract maintenance program. Implementation decisions and actions will in many cases determine the ultimate success of the contract maintenance program.

In this chapter the decision process to determine whether or not to contract is discussed. The following chapter will present the implementation of contract maintenance decisions.

DECISION PROCESS

The decision whether to contract or not to contract should be based on an objective determination process that provides consideration of the significant factors involved. Such a process is shown in Figure 4 and involves making determinations concerning:

- The *requirement* to contract
- The *need* to contract
- The *feasibility* of contracting
- The *desirability* of contracting

The subprocess used in determining the requirement to contract is included on Figure 4. The subprocesses used to make the determination for need, feasibility, and desirability are shown later in this chapter.

The process is based on the premise that contracting will be used only when agency policy permits contracting. In those cases where no policy exists the process requires that it be established. The process is also based on the assumption that contracting will not be undertaken unless required by policy until agency maintenance resources are fully utilized or the agency has no means to accomplish the work with in-house resources. Based on the current practices reported in Chapter 2 this assumption is valid for most agencies.

Four decision outcomes are possible using the contracting decision process shown in Figure 4.

- Contracting is not required
- Contracting is required
- Contracting is recommended
- Contracting is not recommended

Contracting is not required if the agency policies do not permit contracting or if work-load requirements do not exceed the agency's capability to perform the work with in-house resources. Contracting is required when it is prescribed by law or policy. One agency reported that it is required by law to contract a maintenance activity if the annual expenditures exceed a prescribed threshold. Other agencies may have the same or similar statutes. Other agencies have established policies that prescribe the activities that will be contracted. Whenever the contracting of maintenance activities is required by law or policy the decision to contract has previously been determined. The determination process used in establishing the policy should have included consideration of the need, feasibility, and desirability of contracting the maintenance activity.

Contracting is recommended in those cases where a work-load need exists, the agency does not have sufficient resources, and contracting is both feasible and desirable. Contracting is not recommended in situations where the feasibility and desirability of contracting is determined to be negative or questionable. Under some circumstances the manager may decide for other reasons to contract in spite of questionable feasibility and desirability determinations. Should that happen, the determinations should provide information and insight as to what must be done to overcome the negative aspects and increase the chance of success in that particular contracting situation.

The evaluations and determinations cannot be effectively accomplished without the proper information available. Information required to be assembled or developed for use in these decision processes includes:

- Agency policy concerning contracting of maintenance activities;
- Specific objectives to be achieved by contracting;
- Work program needs in terms of activities and resources;
- Agency maintenance resources (personnel, equipment, materials);
- Availability of suitable contractors;
- Capability of agency staff to develop maintenance contracts;
- Capability of agency to manage, inspect, and control contracts;
- Identification of management concerns involving contracting; and
- Agency and contractor costs.

The information requirements and use are described in the discussions of the contracting decision process and subprocesses.

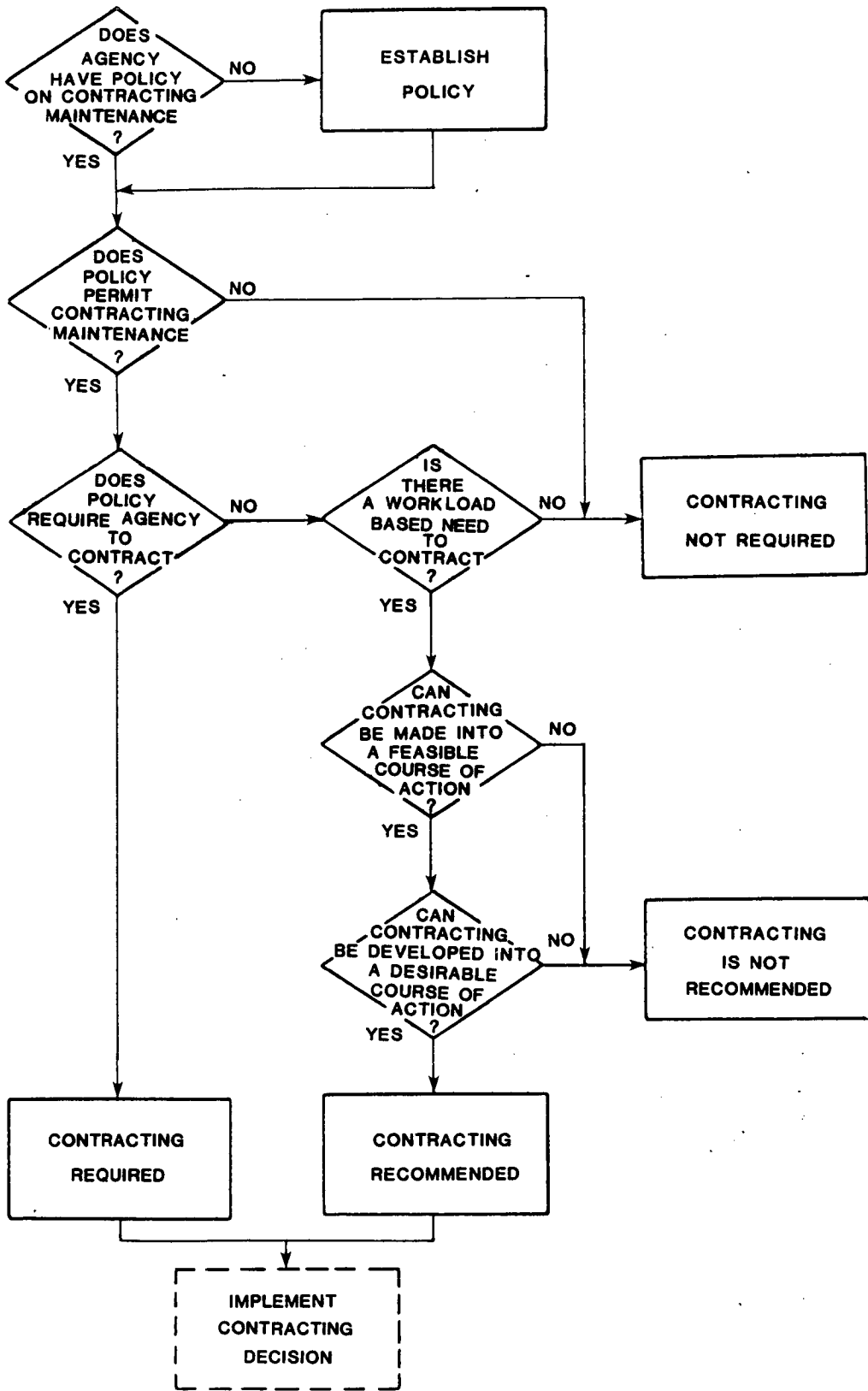


FIGURE 4 Contracting decision process.

Agency Policy

To ensure that maintenance contracting decisions are made within an established framework, it is important that the agency formulate policies and guidelines on contracting maintenance activities. This policy does not need to be rigid but should provide the basic rules and criteria under which decisions will be made. The policy should address the following items.

- Agency philosophy or practice with respect to the contracting or maintenance activities and the conditions under which contracting will be considered.
- Objectives to be achieved through contracting maintenance activities. The objectives should be formulated to mesh with the long-term plans and maintenance programs of the agency and should consider the concerns and various points of view of those who will be affected by the contracting of maintenance activities.
- Guidance concerning activities that will be contracted as a matter of policy.
- The types of contracts to be used in contracting for maintenance activities.
- The level of contractor experience and capability desired by the agency and the use of disadvantaged business enterprise contractors.
- The methods to be used in the development and training of contractors to perform maintenance, and the extent to which the agency will provide this development and training.
- The requirements for cost comparisons between agency costs and contractor bids. The cost items to be included and used in the comparisons.
- Actions that will be taken if bid prices are excessive. Elements that constitute excessive contract prices should be stated.
- The mitigation of tort liability risk associated with contracting maintenance activities. The methods to be used and the allocation of risk between the agency and contractor should be addressed.
- The requirements for bonding of the contractor.
- Guidance for payments to contractors that considers the need for cash flow to the contractor.
- The responsibilities of organizations within the agency with respect to contract development, procurement, administration, inspection, and control.

DETERMINING THE NEED TO CONTRACT

Contracting should not be undertaken unless there is a requirement to perform the work based on work load. To objectively consider the need for contracting maintenance, as shown in Figure 5, the decision maker needs information about the annual work plan concerning activities budgeted, their location, the time frame when the work is scheduled, the amount of the work at each location, and the resources needed to accomplish the work. If the plan has not been developed and resource requirements have not been identified, they should be.

From the policy guidance previously developed the amount of work required to be contracted by law or policy can be determined. The remaining work can be accomplished either by contract or in-house, depending on the availability of agency resources.

Historically, many maintenance activities have been performed by contract simply because the agency could not accomplish the work with in-house resources. The agency's available personnel and equipment should be viewed as assets that should be used as productively as possible. Consequently, the time-phased availability of agency resources to meet the work requirements should be developed.

The availability evaluations need to consider personnel turnover, equipment downtime, the physical location of the personnel and equipment, and the agency's policy for assignment and reassignment of personnel and equipment. Agency assets should be utilized to fulfill requirements to the greatest extent possible. The difference between requirements and availability represents the surplus or needed resources to accomplish the work program.

The agency may desire to increase some or all of the in-house resources by part-time and peak-season employment as an alternative to contracting. The workload requirements determine the length of time during which these additional employees are needed, but flexibility in the program is available without contracting.

Once the resource availability and shortfalls are known, those maintenance activities to be performed with available personnel and equipment resources should be identified. Activities needing resources should also be identified as possible candidates for contracting.

DETERMINING THE FEASIBILITY OF CONTRACTING

If there is a need based on work load, the next determination required is the feasibility of using contracting to meet the need. This determination process is shown in Figure 6 and involves consideration of the suitability of the activity for contracting, the capability of the agency to develop and manage the contract, and the availability of contractors to perform the work.

Suitability of Work Activity for Contracting

In most cases a prerequisite to contracting is the suitability of the work activity for contracting. To be suitable for contracting a maintenance activity needs to be:

- Specified and described accurately and in such a manner that contractors will understand exactly what is to be done and why, where it is to be accomplished, when the work is required to take place, and how the work will be measured. The specification needs to be realistic and attainable. If the agency intends to measure and compare effectiveness and costs of the work with that performed by agency forces, the specification requirements and performance standards should closely parallel those used by agency forces. Some activities are easier to specify than others. In some cases the best means of contracting an activity is to simply reimburse the contractor for labor, equipment, and materials used.

- Packaged, so that there is enough volume of the activity in a given geographical area, and within a suitable time frame, to allow the contractor a reasonable level of activity and opportunity for productivity. A proper package of work provides the agency the best possibility for favorable bids.

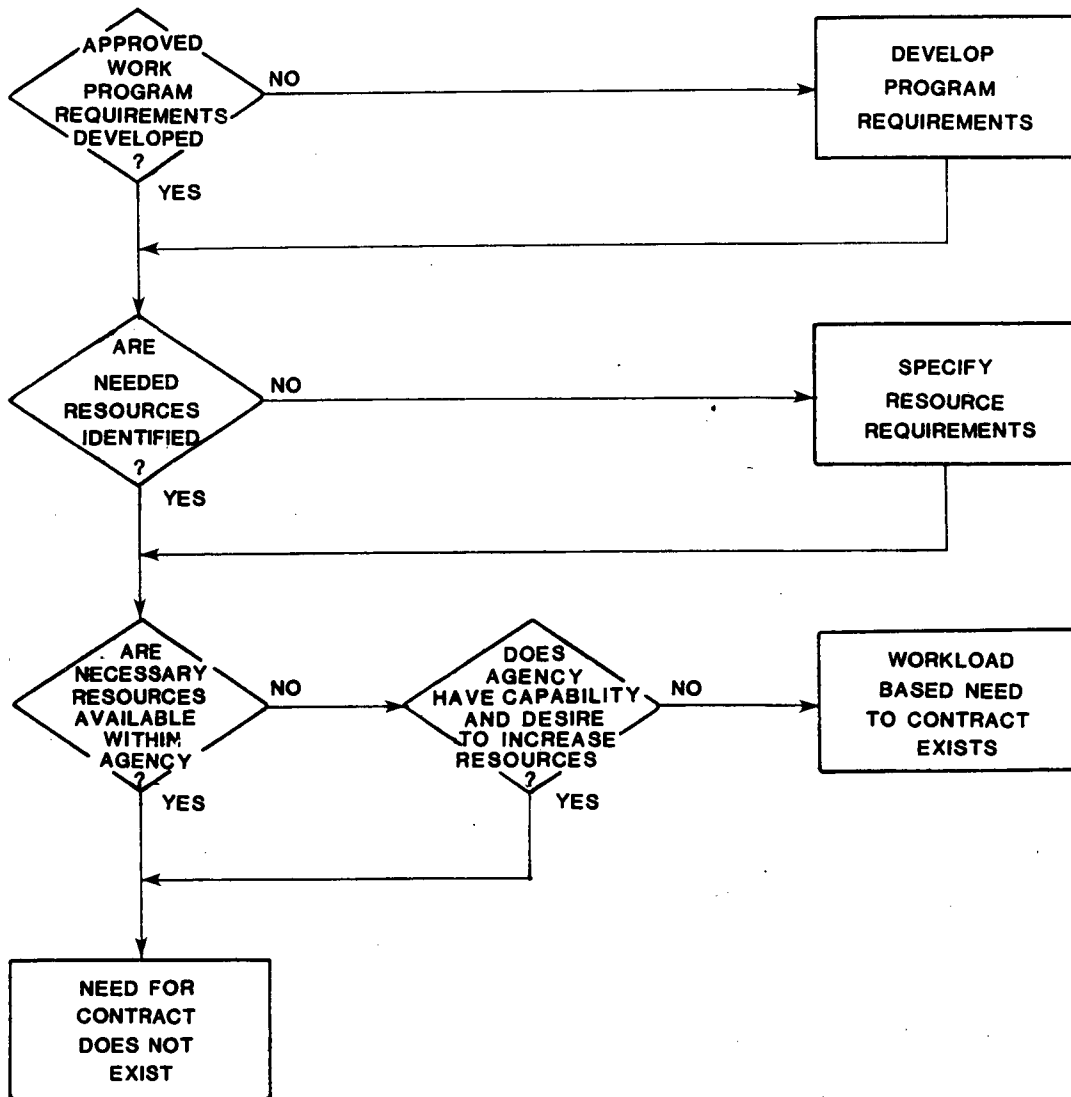


FIGURE 5 Determining need.

- Inspected and controlled to assure the agency that it received the product for which it was paying. Many maintenance activities, by their very nature, are small jobs, but require a level of supervision and control equal to that for larger jobs. For activities that require extensive supervision during the work process and that cannot be controlled by end-of-task acceptance and testing, it may not be cost-effective for the public works agency to contract the work while retaining sufficient inspectors to provide continuous monitoring of the work.

The activities that are candidates for contracting should be evaluated to determine those most suitable for contracting.

Capability to Develop Contracts

To contract successfully the agency needs the capability to develop the contract documents efficiently and effectively. Many agencies are organized and staffed to handle their normal work

load and responsibilities. Initiating contract maintenance or expanding the contract maintenance program can be an additional work load that will degrade the overall effectiveness of the agency's staff.

Maintenance contract documents can be quite time-consuming to develop and usually require considerable effort to coordinate the plans, specifications, pay items, and inspection and control procedures needed to have a good contract document. Consequently, the agency should closely examine its capability to develop the contract documents required.

This examination should include:

- Estimating total effort required,
- Personnel available to develop contracts,
- Experience and capability of personnel in developing maintenance contracts,
- Help available from other organizations in the agency, and
- Ability to contract with consultants for development of the plans and contract documents.

Capability to Manage Contracts

The administration, management, inspection, and control of the contract requires a considerable effort when performed correctly. The contracts should be designed to minimize the requirements whenever possible. However, the agency must still ensure that it is receiving the quality and quantity of work for which it is paying. To do so requires that a level of contract management capability be available to the agency. Depending on the assignment of organization responsibility for maintenance contract management within the agency, this capability may be required in the maintenance organization, the construction or-

ganization, or procurement organization. In any case, acquiring or expanding the capability takes time and the expanded capability may not be available in the required time frame. The capability to handle the proposed maintenance contract program should be evaluated and the evaluation should involve:

- Estimating the resources and effort required,
- Personnel available to administer, inspect, and control contract activity,
- Experience and capability of personnel,
- Help available from other organizations within the agency,
- Ability to contract with consultants for administration,

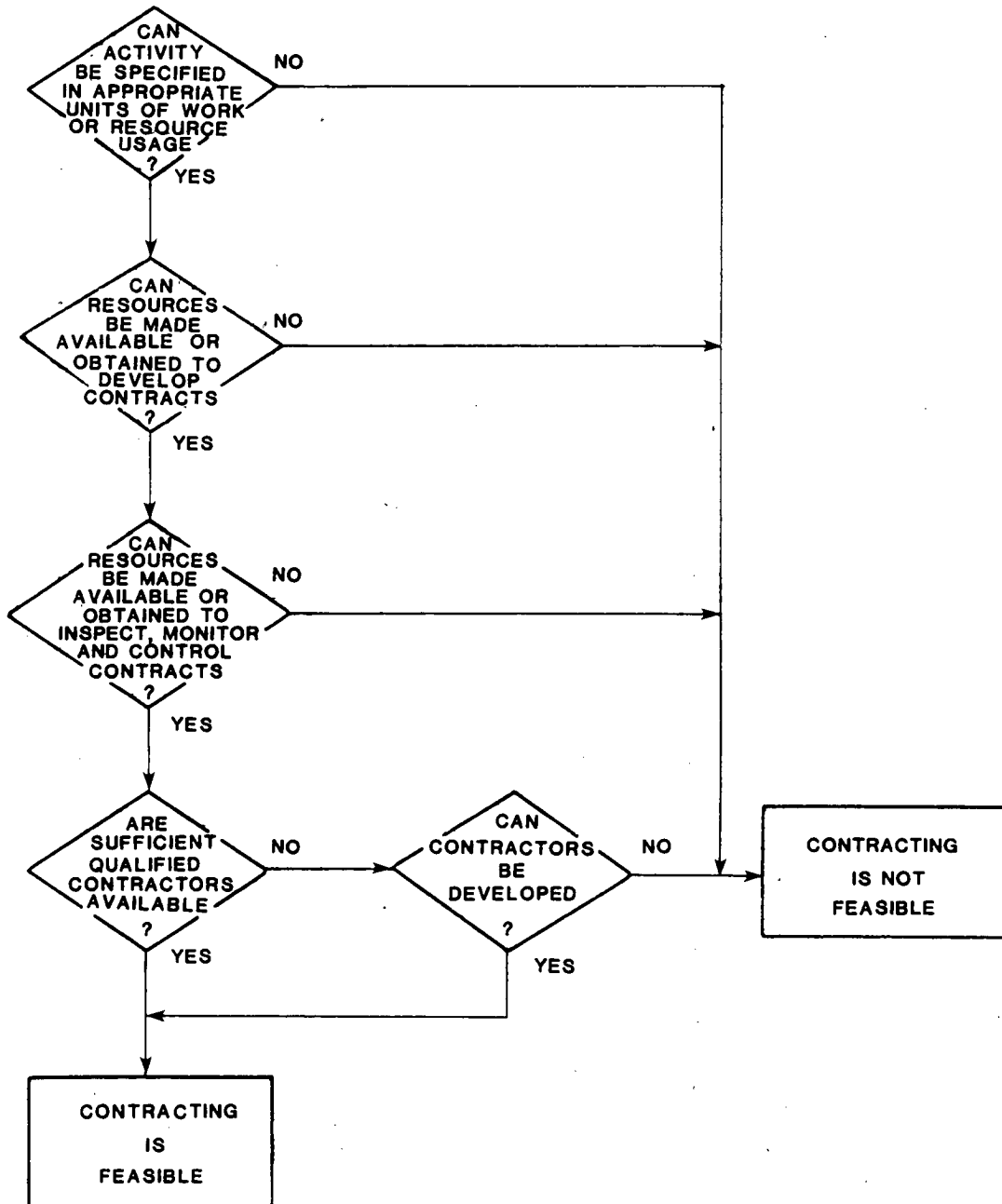


FIGURE 6 Determining feasibility.

inspection, testing, and control activities associated with the maintenance contract.

Availability of Suitable Contractors

When suitable contractor resources are not available to undertake the contemplated contract maintenance program it cannot be successfully contracted. The agency then has no choice but to forego the work or perform it with its own resources. Availability becomes a prime element in determining the feasibility of contracting. Information needs to be assembled concerning the contractors so that the feasibility can be determined. This information should include:

- Numbers of suitable contractors to provide realistic competitive bids,
- Contractors with any specialized skills or equipment needed,
- Contractors available within the geographical area of the work, and
- Contractors with adequate track records of quality work and responsiveness.

If the existing availability of contractors is not adequate for the contemplated contract maintenance program, a determination should then be made as to whether or not the agency will develop contractors. Guidance concerning this should be included in the agency policy toward contracting.

DETERMINING THE DESIRABILITY OF CONTRACTING

Once need and feasibility have been established, the next step in the contracting decision process is the determination of desirability. Figure 7 provides the determination process that is concerned with the achievement of objectives, the elimination of management concerns, and the anticipated costs of the contract.

Achievement of Objectives

The agency policy should provide broad objectives to be achieved through contracting. Whatever objectives are established, the needed contracting program should facilitate their achievement. Established objectives could range from a single straightforward objective, such as "Accomplishing Needed Work," to a series of complex interrelated objectives, which could include:

- Increased service.
- Improved condition of the street and highway network.
- Maintenance accomplished on a planned basis as opposed to a program accomplished in response to complaints.
- Maintaining current personnel and equipment levels regardless of work load.
- Reduction of personnel and attendant short- and long-term personnel costs.
- Avoidance of capital investments in equipment.
- Increased production.

- Reduction of costs.
- Improved capabilities.

Concerns

There are some conditions that may occur in a contracting situation that should be of concern to the manager, and measures should be taken to mitigate the concern. Contracting 100 percent of an activity may leave the agency vulnerable to high bids, unjustified future price increases, and no way to readily handle a situation in which the contractor defaults the contract or is terminated for poor performance. This concern is most applicable for maintenance activities that are critical to the public, such as snow and ice control, traffic services, and emergency work. Some agencies never contract 100 percent of an activity and will reject bids if they are too high regardless of the activity. Others will contract an entire activity but have alternative plans if the contract terminates unexpectedly; these may include provisions in the contract to take over the contractor's operations if required. Larger agencies have more flexibility in this regard than smaller agencies as they generally have more ability to shift resources between geographic areas and from one activity to another.

These concerns should be addressed in determining the desirability of contracting. If the concerns are overriding, contracting probably should not be attempted.

COSTS

The desirability of contracting will in part depend on the anticipated costs. If the expected costs will appreciably exceed those the agency would experience through performing the work with its own forces, it is generally not a good idea to contract.

Two separate sets of costs should be developed: one for the agency and one for the contractor. Then an equitable comparison must be made. This comparison can be relatively simple and should involve the following cost categories:

Agency Costs	Contractor Costs
Direct Costs of Work and Variable Overhead Costs Attributable to the Activity	Total Bid Item Costs Agency Costs of Bid Preparation and Agency Costs of Supervision of Contractor

Agency costs should be based on cost records from their maintenance management system or financial system. Estimates of contractor costs can be developed from past contracting experience, knowledge of prices in the geographic area, or by asking contractors to provide nonbinding quotations for doing the work.

It must be emphasized that before considering relative financial costs, the decision maker must be absolutely positive that similar performance requirements are being compared. In too many cases maintenance activities carried out by in-house forces have methods and procedures that have evolved over the years with experience. When these same activities are required to be specified and described in the formats required to obtain com-

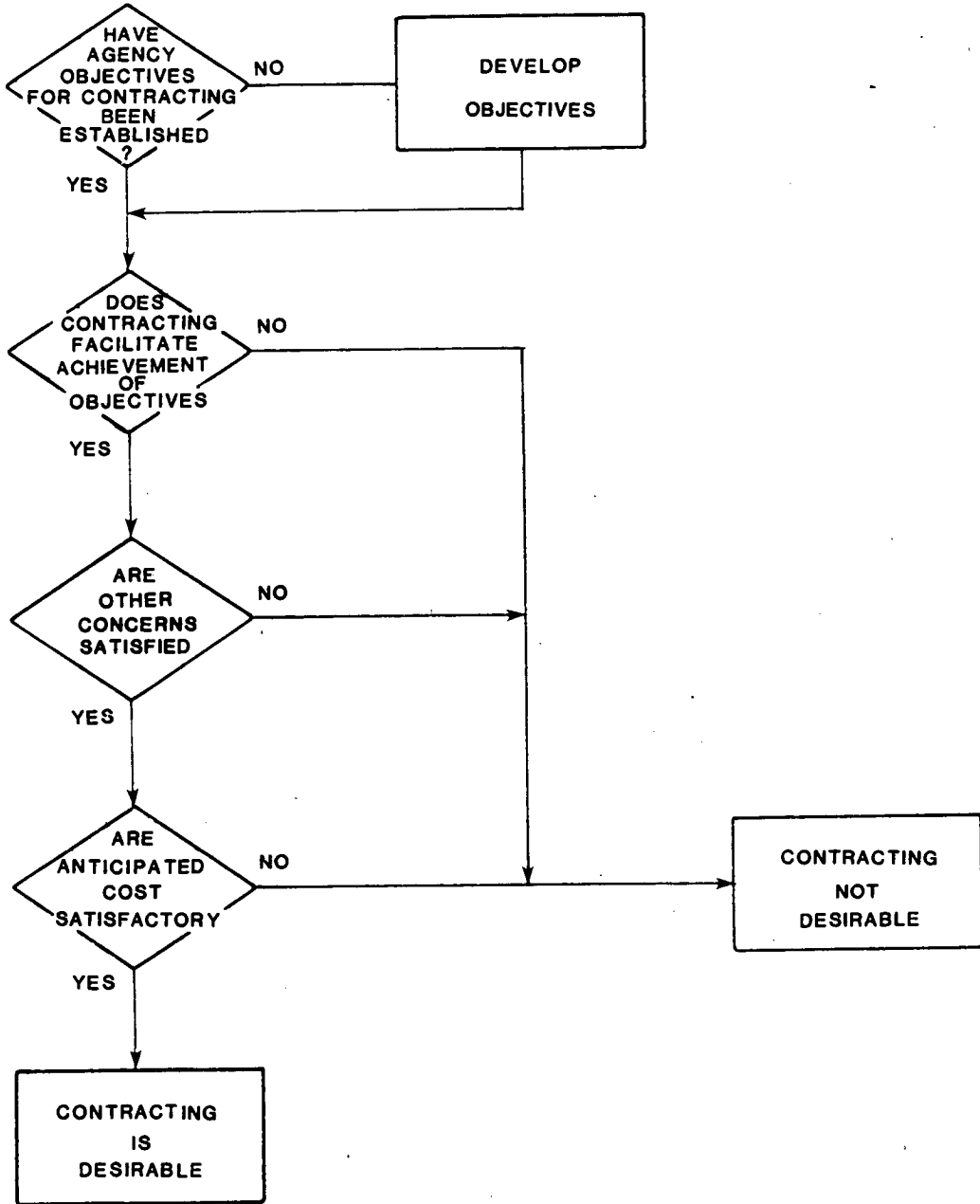


FIGURE 7 Determining desirability.

petitive bids, the performance requirements for the contractor (as described in the specifications, on which the contractor's bid is based) may exceed the levels of performance normally obtained by public works forces. Costs may exceed the agency's estimate if the estimated costs are based on a lower performance level.

Contractors may on occasion unbalance their bids with respect to specific pay items within the overall bid. This requires that the total contractor bid be compared with total agency costs without consideration of specific pay items. Contractor costs should be modified to reflect supervision and contract control costs and the costs of preparing and inviting bids, since these costs would not normally occur when using in-house forces.

Once activities are on a comparable performance basis, relative costs can be compared. For comparison, costs can be grouped into three basic categories.

- *Direct costs*—Those costs involved directly with the activity in question, and which would not occur if that activity did not take place.

- *Variable Overhead Costs*—That proportion of overhead costs that are incurred only because a particular activity takes place.

- *Fixed Overhead Costs*—Those costs that would accrue irrespective of the decision to undertake an activity with public works forces or with contractors.

For a public works agency, it is suggested that cost items be assigned to categories for each activity as shown in Table 13.

If cost comparisons show that contract maintenance is less expensive than use of agency forces, the only way to realize the savings is through a reduction in the agency maintenance staff.

TABLE 13
ACTIVITY COST CATEGORIES

Activity	Direct Costs	Variable Overhead Costs	Fixed Overhead Costs
Labor	Direct labor salary	Fringe benefits applied to direct labor FICA and retirement applied to direct labor	
Equipment	Equipment charges for the activity		Office and shop costs (except as reflected in equipment charge rates)
Material	Material costs	Materials handling and storage for that activity	
Administration		Testing, inspection, and design applicable to that activity	General administration overhead

However, a balanced work force must be maintained so that all necessary year-round activities are performed. Thus, the activities to be contracted (and the corresponding staff reductions) must be carefully selected to ensure continuous and safe traffic operations.

IMPLEMENTING THE CONTRACTING DECISION

INTRODUCTION

The contracting decision process presented in Chapter 3 centered on making objective determinations concerning requirements to and need for contracting and the feasibility and desirability of contracting maintenance activities. If the determinations are favorable and the decision has been made to contract, then actions must be taken to implement the decision. The manner in which the implementation actions are taken will have a significant impact on the ultimate success of the contract maintenance program of the agency.

The contracting of maintenance activities in many circumstances is a complex task and often requires engineering and maintenance skills and ingenuity equal to or greater than those required for contracting the construction of new projects. The main reasons for this include:

- Requirements that the repairs may have to duplicate adjacent conditions for performance, safety, or appearance reasons.
- Requirements to package into a single contract similar maintenance activities covering highway facilities of different ages with different design parameters, materials, and use.
- The uncertainty involved with defining and specifying the actual work and quantities because of hidden or unknown conditions.
- The lack of applicable standard specifications and quality control procedures.
- Project restraints involving materials, equipment, time, and costs.
- Requirements to coordinate contract work with other agency work and operations.
- Requirements to provide maintenance work site traffic safety.

Not all maintenance contracts will be complex. Contracts for maintenance activities that parallel the type of work normally performed by the construction and service industries may be much easier to compile and inspect than those that involve activities that have not traditionally been contracted.

Regardless of the complexity, the contracting of maintenance activities should not be attempted until the agency is organized and prepared to undertake such a program.

ORGANIZING FOR CONTRACTING MAINTENANCE ACTIVITIES

Organizing to accomplish maintenance activities by contract involves a significant advance preparation effort. The actions and decisions that need to be accomplished include the following.

- Developing the approach to be used to implement the contract maintenance program in order to engender the support needed.

- Defining the organizational functions and activities required.
- Assigning organizational responsibility and authority.
- Determining levels of effort and required staffing.
- Identifying and developing procedures, policies, and methods.
- Assembling the necessary data and information to support the contract maintenance effort.

This advance preparation will considerably improve the efficiency and effectiveness of the organization in the contract maintenance area and help ensure a successful program. The actions may take a significant amount of time to accomplish and must be initiated well in advance of the time when the contracted maintenance work is required.

Approach

The implementation of a contract maintenance program requires organizational support. When an agency initiates a new program, such as contract maintenance, it must be recognized by all concerned that established procedures will change. The work assigned to the agency's work force may change. Job descriptions will change and the demand for different types of skills must be met. Organizational responsibilities may change and established methods of dealing with the public may require revision.

Although these changes need not be revolutionary, any change in organization and procedures often causes concern among employees. This concern often leads to a lack of organization support for implementing the changes. Therefore, to prevent morale problems and concern for job security, a well-thought-out, methodical, and possibly time-phased approach should be made to the implementation of a contract maintenance program. The approach taken will depend to a large degree on the amount of contracting contemplated and the objectives to be achieved. If in-house efforts are being supplemented, then the approach to implementation is relatively straightforward. However, if portions of the work force are to be replaced by a contract work force then the approach must be entirely different.

Depending on the maintenance activities and the amount of contracting planned, a time-phase approach may be required in order to proceed at a level of contracting activity that the agency can effectively implement. Time-phasing allows an agency to increase its capability and experience with contracting at a planned rate and also provides time to develop a pool of qualified contractors. On the other hand, circumstances may require an immediate implementation of the entire contract maintenance program. The approach chosen by the manager should support the long-range plans and objectives of the agency because once committed to contracting it is often difficult for the agency to reconstitute the contract portion of its effort as an in-house activity.

Functions and Activities

In any contracting situation the organization is concerned with addressing four basic questions:

- What do we want?
- How do we order it?
- How do we procure it?
- Did we get what we ordered?

Planning and design functions address the question of what is wanted. Planning involves the determination of the needs, requirements, and desires of the agency with respect to the project. Design translates these planning parameters into concepts and criteria. The design concepts and criteria are incorporated into plans and specifications that provide the means to order what was wanted. The overall quality of the contract maintenance activity can be no better than that reflected in the plans and specifications.

Contracting addresses the question of how to procure. Contracting is a formalized process for procurement mandated by federal, state, and often municipal laws and requirements. In most jurisdictions the procurement laws require that purchases above a specified amount (with some limited exceptions) be subject to competitive bidding. These laws generally include the requirements for advertising bids, the mode of processing bids, the method of determining the responsible bidder, and procedures for making the award. Compliance with the procurement laws requires that the agency allow sufficient lead time to accommodate the advertising and bid preparation times specified in the laws.

Answering the question "Did we get what we wanted?" is accomplished through inspection, quality control, and acceptance procedures. The need for inspection and quality control is always present to ensure an acceptable end product. The inspection activities involve monitoring, checking, observing, and recording of the contractor's activities to ensure compliance with the plans, specifications, and other contract provisions. The place, frequency, thoroughness, and type of inspection and quality control activities may vary depending on the maintenance activity, type of contract, and the quality of the contractor's work.

Acceptance is the procedure through which the contracting agency either accepts or rejects the contractor's work. The inspection and quality control activities identify work or materials that do not meet specifications. The agency can accept, reject, or assess price penalties for substandard work or materials. The contract should clearly spell out what procedures the agency will follow if the contractor's work does not meet the plans and specifications.

Organization, Responsibility, and Authority

Organizational structures of public works organizations will vary considerably and few will have exactly the same organizational structures, functions, and procedures. Organizational logic at any time is driven by local conditions, funds available, assigned responsibilities, personnel capabilities, and the organization's position and responsibilities within the governmental system. Consequently, there is no standard organizational struc-

ture for accomplishing the contracting of maintenance activities. The important consideration is that the responsibility and authority for all of the functions and activities required are assigned. Responsibility clearly designates an individual occupying an organizational position to perform or supervise each function or activity. Authority grants him or her the legal and organizational power to perform the activities for which he or she is responsible.

In many instances there will be sufficient long-term activity to warrant the establishment of a separate organizational element to be responsible for the contract maintenance program. If such is the case it should be seriously considered as this is the most efficient and effective means to accommodate the contracting work load. Imposing a large contracting work load on the existing organization can be very disruptive to normal activities and will likely degrade the effectiveness and efficiency of the entire organization.

Unless there is a sufficiently large and continuous contract maintenance program to justify a separate organizational element, the responsibility must be assigned to various individuals in the agency's organization, or to individuals in other organizations within the government system. This is a fairly normal situation in many government organizations as individuals are designated to be responsible for more than one function. For example, there could be an individual with primary responsibility for planning who also helps with design and developing the plans and specifications. Likewise, a maintenance foreman may be primarily responsible for roadway maintenance and helps out with inspection and quality control. These cross-functional assignments should not be made indiscriminately but should be planned to match an individual's work responsibilities, skills, abilities, and desires.

An analysis of personnel requirements for each functional area should reveal the potential for cross-functional assignments, training needs, and additional and surplus personnel requirements. This analysis need not be overly elaborate. An example of such an analysis is shown in Table 14. The number of required person-years for each function is based partly on current needs and partly on a forecast of future needs. Both current needs and future needs will be affected by the expected changes in the contract maintenance program and the approach chosen to implement the program. As the contract program progresses the staffing requirements will change as various functions are completed or the initial work is done. For example, once the contract maintenance program is planned, the staffing requirements for planning may well be reduced while staffing for developing plans and specifications may need to be increased. Once the majority of original specifications is prepared, this activity will reduce to a lower level of effort while the staffing needs for inspection increase.

In addition to developing personnel requirements, the skill requirements must be determined and analyzed against available skills. This will reveal the potential cross-functional assignments, develop the requirements for training to provide new or enhanced skills in personnel, or show where to add personnel with the needed skills.

Once the organization analysis is completed, personnel authorizations must be changed, new job descriptions should be written, and any necessary actions should be initiated to reclassify personnel. Training programs should also be developed to provide the required new skills to the organization's personnel.

TABLE 14
PERSONNEL ANALYSIS (REQUIRED PERSON-YEARS)

Function	Personnel Classification											
	Engineer	Planner/Maint. Engr.	Engineering Tech.	Contracting Officer	Administrative Asst.	Superintendent	Inspector/Foreman	Equipment Operator	Mechanic/Welder	Clerical	Laborer	Total
Management Control	0.5				0.5					0.5		1.5
Administration					1.0					1.0		2.0
Engineering Division (management)	0.25		0.5							0.5		1.25
Planning and Design		1.0	2.5									3.5
Subdivision of Permits and R.O.W.					1.0							1.0
Inspection/Quality Control	0.5		1.5				2.0			0.5		4.5
Maintenance Division (management)	0.25	0.5			1.0	1.0				1.0		3.75
Vehicle and Equipment Maintenance						1.0		2.0	16.0	0.5	2.0	21.5
Roadway Maintenance						1.0	3.0	26.0			6.0	36.0
Mowing and Ditching						1.0	3.0	20.0			6.0	30.0
Supply and Procurement				1.0	1.5	1.0		2.0		0.5	2.0	8.0
Traffic Services						1.0		4.0			2.0	7.0
Total Required	1.5	1.5	4.5	1.0	5.0	6.0	8.0	54.0	16.0	4.5	18.0	120.0
Currently Available	1.0		1.0		2.0	8.0	6.0	40.0	18.0	5.0	6.0	87.0

Staffing

Following the establishment of the organizational structure to accommodate the contracting of maintenance activities, staffing becomes the next critical action.

The number of staff required from the organization and personnel analysis less the number available gives the number of personnel needed for each personnel classification. Personnel shortfalls can be accommodated by:

- New permanent or seasonal hires
- Promotion/transfer
- Cross-functional assignments
- Use of consultants

Agency personnel regulations must be followed in obtaining the required staffing. These regulations prescribe the process that must be followed. The lead-time involved with the personnel acquisition process must be considered in order for the individual to be on the job at the proper time.

The use of consultants is a means for the agency to staff for peak or temporary work loads or to provide temporary staffing in the initial stages of a program. Obtaining consultants in many government jurisdictions is also a long-lead-time process and should be initiated in sufficient time for the consultant to be available when needed.

Policies, Procedures, and Methods

Policies, procedures, and methods should be identified and developed as part of the advance preparation work. This will ensure that the contracting of maintenance activities is conducted within an established structure that everyone knows and understands. In Chapter 3 the items that should be included in the agency's policies were listed and it was recommended that these policies be developed to provide a framework for decision making. If the policies were not established before or during the contracting decision process, they will need to be established as part of the advance preparation work.

Procedures and methods should also be identified and developed to implement the policies, control the production of the contract documents, ensure proper contract award, and provide for inspection, quality control, acceptance, and payment of the contractor. Many of these procedures and methods will already be in existence within the agency. These must be assembled and reviewed. The review should identify those items that are applicable to the contracting of maintenance activities and those that are not applicable or require modification. Other needed procedures and methods must be developed. For example, the inspection quality control and testing procedures used for road and street construction may be overly rigid or too elaborate for maintenance overlays or pavement repairs. These must be modified to fit the maintenance situation. New procedures may be

required when existing procedures do not address the subject matter.

The contracted maintenance activities need to be accomplished at the proper time. The times involved in producing the contract documents and awarding the contract require that careful attention be paid to the process and procedures and operational schedules needed. This could well require that the process begin six to nine months or further in advance of when the work is required to be started. Management procedures may be needed to ensure that the production of contract documents advances according to plan.

Information Requirements

The agency needs to assemble a data base to support the contracting of maintenance. Having the required information available in a form that is readily retrievable will vastly improve the efficiency of developing and awarding contracts. The basic information needed includes both cost and project data. Other desirable information would include any contractor information available, such as costs, capabilities, and performance, and samples of contracts developed by other agencies for maintenance activities.

Cost data are needed to develop cost estimates, analyze bids, and negotiate changes. A discussion concerning the development and use of cost data was presented in Chapter 3.

IMPLEMENTATION

Once the agency is organized to handle contract maintenance it should proceed with implementation. The major work efforts involved are:

- Final establishment of the contract maintenance program,
- Development of individual projects,
- Development of contract documents,
- Advertising and award of contracts, and
- Contract management.

These work efforts are accomplished through the organization functions described earlier in this chapter.

Establishing the Contract Maintenance Program

The process utilized in deciding which activities to contract is the foundation for establishing the contract maintenance program. This process establishes which activities and the amounts that should be contracted. The contemplated contract program may require modification as a result of:

- Budget changes
- Organizational constraints
- Coordination of work with agency forces, utilities, and other contractors
- Productivity improvements in agency work force
- Rehabilitation, reconstruction, and improvement projects

In any case, the contract program should be reviewed and reevaluated and modified as necessary to establish a final pro-

gram that meets the objectives of the agency. Ideally the program should be established for multi-year periods with specific projects identified for each budget year. The projects in the program should be prioritized for accomplishment. The methodology used to establish relative priority among projects should include physical maintenance needs as well as factors such as political, social, and economic considerations. The project's position on the resulting priority list in conjunction with its completion date and required lead time should establish the sequence in which the project enters the agency's production pipeline for design, contract document preparation, and contract award.

Development of Projects

The projects or maintenance activities identified for contracting need to be further developed so that they are properly planned and designed. The project development efforts begin with planning activities that develop the needs and requirements and coordinate these with other activities that are scheduled. Individual projects may also need to be combined into larger projects in order to provide sufficient quantities of work in individual contracts. In other cases, projects may need to be accomplished in phases by different contractors because of the types of activities involved. Projects may also be divided into smaller projects in order to take advantage of simplified procurement procedures or to provide projects that are within the capability of available contractors.

Once the final project is defined, the preliminary engineering should be accomplished so that design criteria and concepts can be formulated and any cost trade-offs can be made. Preliminary engineering activities include a thorough analysis of site conditions and any studies to determine the best technical approach to meet the needs of the project.

Normally design is performed by either in-house personnel or by consultants. For the design of maintenance projects there are some advantages for performing the design in-house. In-house design provides:

- Utilization of existing knowledge and maintenance expertise within the agency,
- Development of a pool of expertise within the agency,
- Immediate access to the history of specific designs, and
- A final design that may be more responsive to the local situation.

Consultants may be retained for the accomplishment of services related to design development of plans and specifications and providing construction management activities. The critical factor is that the agency has a clear definition of what is desired and needed and can convey an accurate description of its requirements to the potential consultants. Consultants should be selected and retained on the basis of experience with meeting similar project requirements, the knowledge and experience of its proposed personnel, and fairness of the fee structure.

Development of Contract Documents

The contract documents that must be developed are commonly referred to as a bid package. A typical bid package

includes the contract, plans, specifications, bond requirements, and information to bidders on the bid process.

Contract

The document governing all procedures to be followed in the supply of materials, the supply of maintenance services, or the construction of a project is the contract itself. The contract should include by reference the standard specifications, any necessary special provisions, supplemental specifications, and the plans. The contract must clearly establish the work to be performed, the amount and method of reimbursement, and the duties and responsibilities of all parties.

Specifications

Specifications are precise, written descriptions of the material, product, or services being purchased. The writing of detailed specifications is a time-consuming effort. It is recommended, at least initially, that existing specifications be reviewed and those that appear to be most applicable used directly or modified as necessary. Modifications may be required because requirements are too strict or testing is too costly or beyond the capacity of the agency. Sources for specifications include:

1. State transportation agencies
2. Municipalities
3. Trade associations, manufacturers, and suppliers
4. Professional societies
5. Federal government agencies

The specifications used should, if possible, be those that local contractors and suppliers are familiar with. This will provide better compliance and probably more competitive costs.

- State specifications—On construction and maintenance projects using state or federal funds the use of state specifications or specifications approved by the state are usually required. One significant advantage of adopting state specifications is that local contractors often are familiar with their requirements. Disadvantages are that the specifications may include requirements that are too strict for maintenance needs or that do not address locally available options and materials. State specifications may require testing or inspection that are beyond the capabilities of some agencies. Another possible disadvantage is that contractors involved primarily in municipal projects may not be familiar with state specifications.

- Municipalities—Specifications used by municipal jurisdictions will also generally have the advantage of being familiar to local contractors, but they are frequently not as comprehensive as the state specifications.

- Trade associations, manufacturers, and suppliers—Representatives for trade associations, manufacturers, and suppliers can often furnish specifications for their products that can be adapted for use. Caution must be exercised and the agency must be certain that the specifications do not rule out use of other equally satisfactory products and that the specifications require the proper level of quality.

- Professional societies—Professional societies, such as the American Society of Civil Engineers (ASCE), frequently provide technical information to members. The National Association of County Engineers (NACE) can be used to arrange an information transfer among municipalities. A municipality needing expertise may request technical assistance from NACE. With the aid of NACE, a county that has had successful experience in addressing a particular problem can aid the agency in need by supplying assistance. The Institute of Traffic Engineers (ITE) prepares suggested specifications of traffic signal systems, pavement markings, signs, and other related features. The American Public Works Association (APWA) is oriented toward the needs of municipal agencies. APWA frequently publishes suggested specifications.

- Federal agencies—Federal agencies have been active in the contracting of maintenance activities. In particular the Department of Defense (Army Corps of Engineers, Navy Facility Engineering Command, and the Air Force Civil Engineering Command) has contracted for a wide variety of maintenance services. The Department of Energy also has an active program of contract maintenance and operations activities.

Specifications previously used for contracting maintenance can be obtained from the list of agencies in the Appendix that responded to the survey discussed in Chapter 2.

Plans

Plans provide a graphic description of the work required by the contract. Plans complement the specifications and provide information as to locations, dimensions, treatments, sequences, schedules, materials, etc. The contracting of some maintenance activities may require extensive plans while other activities may require no plans or only rudimentary plans. Plans should be developed as necessary for each project. A good source to consult is the record plans for the facility. These should provide a substantial amount of information that can be used directly.

Bond Requirements

Contracting via a bid process requires an investment by the agency in terms of time as well as funds. To protect this investment and to ensure compliance with the terms of the contract, bidders are often required to post bonds. With maintenance contracts the requirement for bonds must be carefully considered. Bond requirements may well preclude contractors who cannot obtain bonds (but are otherwise qualified) from submitting bids. Bonding is a problem for many small and disadvantaged business enterprises and contractors. The types of bonds that might be required include:

- Bid proposal guaranty bond—These bonds, in amounts determined by the agency regulations, may be required from each bidder. They are returned to the bidders as soon as the bid is determined to be unsuccessful, or in the case of the successful bidder, upon the signing of the contract performance bonds.

- Performance bond—Upon award of the contract, the successful bidder must submit a surety bond in accordance with the agency regulations as a guaranty that the work will be

performed or the product supplied in full compliance with the terms of the contract, and that the agency will not be liable for expenses incurred through the failure of the contractor to complete the work as specified.

- **Payment bond**—The contractor must also submit a payment bond as specified by the agency to ensure prompt payment by the contractor for materials, labor, and equipment rental used in performing the work.

- **Maintenance bond**—In some cases a maintenance bond is required before final payment for the work. When used, a maintenance bond usually remains in effect for a period of at least one year beginning with the final acceptance date. Maintenance bonds are not permitted on federally funded projects.

Liability

To protect the agency from liability that may occur as a result of accidents associated with the work, the contractor is usually required to have insurance coverage for vehicles, job-site injuries to the contractor's work force, and damage caused by negligence. These insurance requirements are usually well established for most government agencies. Some states are now also requiring contract clauses that, in effect, require the contractor to be responsible for any tort claims arising from the contracted work. For many maintenance contracts this clause may not be justifiable in economic terms. It also may limit the field of contractors to only a few. Inclusion of such a clause should be carefully considered. Additional information on tort liability is contained in NCHRP Synthesis 106, Practical Guidelines for Minimizing Tort Liability.

Information to Bidders

The bid package also provides information to bidders on the bid process including dates, selection criteria, and special requirements. Dates include the scheduled bid opening, anticipated date of contract award, notice to proceed date, completion date, and other key dates such as pre-bid and post-award conferences. The purposes of these conferences are defined as follows.

1. **Pre-bid Conference**—A pre-bid conference is often scheduled. The purpose of this meeting is to answer questions that potential bidders may have about the project requirements and to ensure that all bidders have identical information before preparing their bids and proposals. For maintenance contracts it is important that the potential bidders fully understand what is required, the methods to be used, the expected schedule, special equipment or personnel requirements, and any other information that could add to their understanding and appreciation of the project.

2. **Post Award Conference**—Before the start of work, a preliminary or pre-construction conference is often held. The purpose of this conference is to discuss the scope of the project, to discuss all essential matters pertaining to the satisfactory project completion, and to resolve any questions regarding contract interpretation.

Selection criteria will include, at a minimum, adherence to stated specifications and stated contract terms. Special require-

ments may include Buy America provisions and minority participation.

Reimbursement

The contract should clearly spell out the method and schedule of payment for the work and the procedures that the contractor must follow to be paid. Every contractor is interested in maintaining a positive cash flow. Many contractors do not have substantial cash resources and cannot afford long periods between reimbursements for satisfactory work performed. For maintenance contracts the payment procedures should be carefully considered in order that a financial impediment is not created that limits competition to only those contractors with the financial resources to carry the work for long periods of time. The method of payment is determined by the type of contract. Three basic types are used in maintenance contracting.

1. **Lump-sum contracts**—are used primarily for projects when the work is clearly defined and little or no variation in quantities is expected. Lump-sum contracts require little or no measurements, so there may be a tendency to relax inspection requirements, although quality inspection activities are still required. Reimbursement is usually scheduled on a percent of completion basis.

2. **Unit-price contracts**—are used when variations in quantities are expected. Unit-price contracts offer a fair arrangement whereby the contractor is paid for what is delivered, and the agency retains a reasonable degree of control over the amount of product it receives. Unit-price contracts require inspection effort and record keeping on the part of the agency. Reimbursement is scheduled to conform with the work performed.

3. **Cost-reimbursement contracts**—are useful when the scope of work and quantities cannot be accurately determined before letting the contract, such as unforeseen emergency repair work. Cost-reimbursement contracts pay the contractor for labor, equipment, and material costs at predetermined rates. These contracts involve a great deal of inspection and record keeping on the part of the agency to verify the contractor's charges.

Duties and Responsibilities

A contract is a binding document that places certain responsibilities on both the agency and the contractor. The agency has a responsibility to the contractor to pay for the product or services it receives and it has a responsibility to its taxpayers to ensure that the product is received or work is completed in accordance with the contract specifications. The contractor has a responsibility to provide the product in accordance with the terms and conditions of the contract.

Plans and specifications establish contractual requirements. As long as these are made known to prospective contractors before submitting bids, public agencies must assume that the contracted price fairly compensates the successful bidder for all costs associated with complying with the specifications. Agencies have the right and duty to expect full compliance. To do otherwise gives the contractor an unfair advantage over competitors, who prepared their bids expecting to be required to fully comply with specifications.

Plans and specifications establish requirements that represent the culmination of planning and design efforts. Inspection, sampling, and testing are quality control procedures that are designed to enforce the plans and specifications. The specifications should include inspection, sampling, and testing requirements and responsibilities as well as the procedures the agency will follow if the work is not in compliance with the specifications. Effective recourses that may be available to the agency if included in the contract are:

- Exercising of performance bond
- Assessing liquidated damages
- Adjustment of prices
- Provisions for incentive/penalty payments

Contract Advertising and Award

To obtain responsive competitive bids the agency should carefully plan the manner in which the contract will be advertised. Following the procedures routinely used to obtain construction contracts may not be adequate. Depending on the availability of contractors and their capability and interest in contracting, the agency may need to go to extra efforts to find contractors and interest them in bidding. Some of the techniques that have been used include contractor participation in contract development, prequalification, elaborate pre-bid conferences, and use of contractor trade associations.

When a formal bid procedure is used, the contract is normally awarded to the lowest *responsible* bidder. The agency should always carefully analyze the bids and bidders before any actions are taken.

Checking the Bid

Bids should be checked to ensure that unit prices, quantities, and total prices are accurate; that the specifications are adhered to and that the bidder complies with the stated terms of the proposed contract. Other considerations include quantity and prompt payment discounts and past performance on other contracts.

Bid Tabulation

In addition to carefully checking the bids, they must be tabulated for comparison. Each bid should be compared with other bids and the pre-bid estimates prepared by the agency. Large discrepancies in unit prices may indicate that the bidder or bidders did not understand what was required.

Estimates

An important tool in the evaluation of bids is the agency's pre-bid estimate. Estimates should be based on quantities that are taken from the plans and on historic cost data from the agency's records or from another agency. Although the estimate is a valuable tool, it should be used only as a guide. The manager's judgment must also be utilized in evaluating bids. The pre-bid estimate may be considerably different from actual bids

because of a number of factors. These might include outdated price information, small or very large quantities, transportation costs, local conditions, or some special event or circumstances such as the oil embargo that occurred in the 1970s. When significant differences do occur between the estimate and the bids, the agency must decide whether there is a need for or an advantage to be gained by rebidding or changing the project. For example, if bids are high and erratic and the number of bidders is small, it would probably be advantageous to re-bid, particularly if additional contractor interest can be generated.

Award

Once the bids have been checked, evaluated, and tabulated the agency should determine whether or not a re-bid is required. If not, the award of the contract should be made to the responsible low bidder.

Contract Management

Contract management is concerned with the activities required to ensure that the duties and responsibilities of the parties to the contract are accomplished or that appropriate actions are taken if the duties and responsibilities are breached.

Inspection

Inspection, sampling, and testing are quality control procedures that are designed to enforce the specifications. Inspection activities are normally performed by an inspector.

The role of an inspector is to monitor, check, observe, and record the contractor's activities to ensure compliance with the specifications, plans, and other contract provisions. The place, frequency, and thoroughness of inspection may vary depending on the activity, the type of contract, the type of specification, and the degree of control exhibited by the contractor. The need for inspection is always present and the role of a qualified, competent inspector is a critical one in ensuring an end product of acceptable quality.

The inspector acts as a representative of the agency within the scope of the authority delegated to him or her. The responsibilities of an inspector are to:

- Inspect work performed and materials furnished to the project.
- See that all sampling and testing required by specifications or job site conditions are performed.
- Bring any deficiencies in work or materials to the attention of both the contractor and the agency's manager.
- Reject materials and suspend work that is not in compliance with specifications until the problem can be resolved.

Frequency of Inspection

Ideally, there should be continuous inspection of all activities. For most contract maintenance activities this is not normally justifiable, either as a technical necessity or from an economic viewpoint. Inspection frequency can be:

- One time—Certain activities should, under normal circumstances, require just a one-time inspection. An example would be to check equipment when it first arrives on site. Unless the equipment does not perform properly or an item has been replaced, there is usually no need to repeat this check.

- Critical point—A critical-point inspection is essentially a one-time inspection that must be performed at a specific point in the sequence of work before the next phase takes place. Checking reinforcing steel and forms before placing concrete is an example. Use of one-time and critical-point inspections can greatly reduce the inspection personnel needed. However, a major problem with critical-point inspections can be scheduling and notification by the contractor. It is essential to establish a procedure requiring notification in advance of the need for a critical point inspection.

- Intermittent spot checks—Many activities can be adequately inspected and controlled by either random or regular spot checks as the work proceeds.

- Continuous monitoring—Some operations, because of their inherent critical or variable nature, require the full-time presence of an inspector. Placing of structural concrete is a good example of a case in which full-time or continuous inspection may be justified.

The inspection frequency selected will be based on engineering requirements and project type. Engineering requirements are related to the importance of a particular element. Depending on how critical a certain material, product, or activity may be, consideration should be given to increasing or decreasing the degree of inspection for that element. This might be based on engineering properties, soil conditions, anticipated service conditions, or new and unusual materials or techniques used in the maintenance and repair.

The type of project will also affect the degree of inspection needed. Bridge repairs will require more intensive inspection than roadside mowing. A major roadway will warrant more inspection than a rural, unpaved road. The thoroughness or degree of inspection necessary at the job site will also depend on the quality of the contractor's work.

Sampling

The inspector must have a basis on which to approve materials and material sources. Sampling and testing provide this basis. Sampling is a process of selecting a part or sample that will be used to judge the whole or lot. Tests made on a sample measure the characteristics of only that sample. The validity of conclusions drawn about the lot based on test results of a sample depends in large part on sampling techniques. Sampling is used simply because it is not possible or practical to test all of the material used on a project. Sampling and testing is only one part of a quality control program. Inspection must be used along with sampling and testing. It is the inspector's job to catch obvious problems, even though they have not been detected by the sampling and testing program.

Frequency of Sampling

The larger the number of samples taken, the lower the risk of accepting unsatisfactory material. However, as the number

of samples increases the cost of sampling and testing also increases. Random sampling techniques provide statistical analysis methods to determine the optimum number of samples necessary to reduce to a satisfactory level the risk of accepting noncomplying materials.

The frequency at which samples are taken is one of the major considerations in selecting the type of sampling to use. Factors affecting frequency are:

- Variability of product—materials that have highly variable quality characteristics should be sampled more frequently.

- Use—materials or products that will serve a critical function should be sampled more frequently.

- Previous experience—materials or products from a source that has not been used before or those that have had a previous history of poor performance should be sampled more frequently than those with a record of good performance.

- Significance of tested materials—if the characteristic of the materials being tested has little significance in relation to the actual use, the sampling frequency can be decreased.

- Agreement with specifications—when test results or visual inspections indicate that a product may not be in compliance with the specifications, increased sampling frequency is warranted.

- Purpose or type of sample—acceptance sampling certifies the level of quality achieved in an end product. It also verifies the quality control exercised over the construction process. In many cases acceptance sampling can be reduced by using job control test results.

Testing

Testing is the process of making tests to determine the degree of compliance with the specifications of delivered or constructed material. All tests should be directly related to and referenced in the specifications.

State and private laboratories can assist in determining the type of tests required for a planned construction or maintenance program and a rough idea of the number of tests of each type.

The role of testing is related to the activities of the supplier, the contractor, and the inspector.

- Supplier—The supplier must maintain constant control over the production process to ensure that the material consistently meets the specified level of quality.

- Contractor—The contractor must maintain constant control over the handling, storage, placement, and use of materials in order to produce a street, road, or structure of acceptable quality. Material that leaves the supplier's plant in satisfactory condition will not result in a satisfactory end product unless the contractor exercises proper quality control.

- Inspector—The inspector and the laboratory must work together. The inspector may assist the laboratory by taking samples and performing many of the on-site tests. The laboratory performs tests, evaluates test results and other engineering data, and provides technical support to the inspector. The inspector acts as the final check point in the construction process and plays an important role in detecting changes in the quality of materials that have resulted from improper handling, shipping, storage, and other causes. The inspector must recognize that testing is based on samples. It is likely that some of the tested

and accepted materials shipped on the job site may not conform to specifications and will have to be rejected by the inspector before placement.

It is important to remember that a sampling and testing program is intended to provide an overall estimate of quality. It is not intended to replace inspection or to find occasional substandard areas, although it frequently does. One sample, with adequate inspection, may be more valuable than numerous samples with little or no inspection. By sampling one typical area, an inspector can, by careful visual observation, detect and reject materials and products having different, undesirable characteristics. Additionally, by observing operations and noting placement locations on material weight/delivery tickets, the inspector can reduce the need for extensive testing at a later date that might otherwise be needed to "bracket" an area of noncomplying material. It should also be noted that many samples can be obtained far more easily and less expensively during construction. Uncompacted bituminous concrete and fresh concrete samples are easier to obtain than pavement cores.

Records and Documentation

Documentation consists of making records of the work accomplished in terms of pay quantities and compliance with specifications. Detailed formal documentation of pay quantities is required on contract projects. When responsibility for various parts of the quality control plan are assigned to contractors, suppliers, private engineering consultants, or private testing laboratories, similar documentation should be required from them as well.

A field diary is a basic form of documentation. The inspector must keep a daily log or diary for each project. The inspector's field diary can be of critical importance in settling disputes, determining causes, and finding solutions to particular problems. This is often the agency's only record of what transpired at the job site. It is extremely important that the log be complete and up-to-date. As a minimum, the log should include:

- An entry for each day.
- A description of the day's activities, name of contractor's superintendent on the job, number and type of crews, number and type of contractor's equipment, weather, and temperature.
- Any measurements made to determine pay quantities or compliance should be recorded, with sketches if necessary, to clarify dimensions. If pay quantity data are recorded in separate field books, there should be a cross-reference.
- A daily summary of weight tickets, delivery tickets, and other materials used on the job.
- A record of significant conversations with and directions given to the contractor.
- A record of problems or potential problems with the progress or execution of the work.
- A record of dealings with test laboratories.
- Any visits to the project by local, state, federal, or other officials.

The inspector's field diary serves as an overall record of the project. However, other forms of documentation will also be necessary such as:

- Weight and delivery tickets—Tickets for ready-mix con-

crete, processed aggregate, hot-mix asphalt, and other materials are often used as official quantity records. They should be signed or initialed by the inspector present; placement location should be indicated and time and date recorded. This can also serve as a record of certain field tests, such as concrete slump or asphalt mix temperature.

- Correspondence—Any oral instructions to the contractor by the inspector should be followed up with a letter from the contract administrator. Copies of all correspondence should be retained.
- Certificates of compliance—Materials accepted on a certification basis should be accompanied by a certificate.
- Laboratory test results—All test results should be kept with the project file.

Acceptance of Completed Work

Acceptance is the procedure through which an agency agrees that an item of work, unit of material, or project has been furnished in accordance with the specifications. The acceptance procedure should provide recourse to the agency if there has not been compliance with the specifications. Acceptance is an important element of contracting as it provides for protection against noncompliance with the specifications.

The concept of liquidated damages is an important contractual protection mechanism. Simply stated, liquidated damages are assessed against the contractor for each day that any work remains uncompleted after the time specified for project completion. Liquidated damages are not penalties. They should be structured to represent the cost of inconvenience to the public for not completing a project within the specified time. This cost can be based on the average daily cost to the public agency for staffing and administering contracts of various sizes. The cost of liquidated damages must be determined during the preparation of the job specifications and clearly established in the contract. Care must be taken not to arrive at liquidated damages in an arbitrary manner. Otherwise, they could be considered penalties.

Penalties cannot legally be assessed in a contract unless there are corresponding incentives. There are situations when agencies may wish to consider the use of incentive-penalty clauses, such as when projects or phases of projects involve particularly hazardous situations and it is worth paying a premium to minimize the exposure time. An example might be a bridge deck repair that involves alternative one-way traffic movement on a heavily traveled road. The contract could provide an incentive-penalty clause for the period of time during which the hazardous traffic condition exists. Such a clause would establish the desired period of time and provide for a penalty if the time is exceeded and an equal incentive, or bonus, if the time is less than specified. For the above example, the contract may specify 20 days, with a \$500 a day incentive-penalty. The incentive-penalty amount would be in addition to the liquidated damages. Before using incentive penalty clauses, the agency's legal staff should be consulted.

Agencies using this type of clause must choose the target time very carefully. If it is unreasonably restrictive, the result will be very expensive bid prices or a lack of competition. On the other hand, if the target time is not restrictive enough, then it could be very expensive for the agency.

Price adjustments are another contractual mechanism for

dealing with noncompliance. They usually involve reductions in the amount contractors will be paid as a result of noncompliance with the specifications. Agencies should establish a minimum acceptable level of quality for important items of work. Below this level, the work will not be accepted. Realistically, however, there is a "gray" area between this bottom line and the desired level of quality. In this "gray" area, the remove-and-replace option is simply not feasible. In these cases a system of adjustments can be established that require the contractor to offset the anticipated additional maintenance costs to be incurred by the agency by adjusting the contract price. Types of specifications for which price adjustments might be considered are material quantities and workmanship.

The bonding requirements, previously discussed, also offer a form of protection. A performance bond will provide protection against a lack of performance on the part of a contractor but should not be used as a substitute for adequate inspection and

testing. In many cases, it is only through inspection and testing that a lack of performance can be detected.

Maintenance bonds may be applicable to contract maintenance activities. These bonds provide some protection against undetected poor workmanship and substandard materials. Maintenance bonds of from 10 percent to 100 percent of the contract amount can be required. They should cover a period of at least one year. Maintenance bonds typically require that the municipal agency perform an inspection before expiration of the bond. If no deficiencies are found, the bond will be released. If deficiencies are found, the contractor must perform the repairs or the bond company may be required to bear costs to the agency for repair. As with performance bonds, maintenance bonds should not be used as a substitute for adequate inspection and testing. Poor quality work may not become evident until after expiration of the maintenance bond. In such cases, the agency can initiate legal actions against the contractor.

CHAPTER FIVE

RESEARCH NEEDS

Within the maintenance community many agencies are proceeding with the contracting of maintenance activities. They are accomplishing this through their own efforts and largely without the knowledge of successful and unsuccessful contracting attempts by others. The research conducted for this synthesis indicated two major areas in which additional research is warranted. These are:

1. Development of guide specifications, and
2. Development of inspection and quality control procedures.

Additionally, there needs to be a forum for the assembly and routine exchange of information on maintenance contracting so that the agencies utilizing contract maintenance can benefit from shared experiences.

GUIDE SPECIFICATIONS

There are a vast number of guide specifications for new construction. Some are applicable to maintenance, many are not.

No guide specifications exist for contracting maintenance activities. Current practice requires that each agency develop its own specifications for its maintenance contracts. This is a difficult and time-consuming task. Much time and effort could be saved if a set of guide specifications were developed to aid in this effort.

INSPECTION AND QUALITY CONTROL

Inspection, sampling, testing, and quality control procedures in existence were developed for new construction. Some are applicable to maintenance and some are not. Limitations on maintenance personnel simply does not allow an elaborate inspection and quality control program. Consequently, the whole area of inspection and quality control for maintenance activities needs to be thoroughly researched to provide a cost-effective approach to this critical activity.

BIBLIOGRAPHY

- AASHTO, *An Information Guide for Methods and Procedures in Contract Maintenance*, American Association of State Highway and Transportation Officials, Washington, D.C. (1963).
- AASHTO, "Highway Maintenance by Contract," *Maintenance Aid Digest*, Number 4, AASHTO Committee on Maintenance, American Association of State Highway and Transportation Officials, Washington, D.C.
- AASHTO, "Contract Maintenance," *Maintenance Aid Digest*, Number 24, AASHTO Committee on Maintenance, American Association of State Highway and Transportation Officials, Washington, D.C.
- Allen, G. R. and F. N. Lisle, *Analysis of Maintenance Costing with Emphasis on Contracting versus Using State Forces*, Virginia Highway and Transportation Research Council (September 1982).
- American Road Builders' Association, "The Contract Method," Speech-of-the-Month Club (February 1966).
- Anderson, D. R., "Is State Force Maintenance at the End of Its Road?," paper presented to American Association of State Highway Officials (November 1972).
- Blaschke, B. C., "Maintenance Contractor," presentation at the Transportation Research Board 62nd Annual Meeting, Washington, D.C. (January 17-21, 1983).
- FHWA, "Quality Assurance for Local Governments," Report No. FHWA-1P-83-1, Federal Highway Administration, U.S. Department of Transportation, Washington, D.C. (February 1983).
- FHWA, "Maintenance Practice for Local Roads—Program Administration," Report No. FHWA/PA 84-110, Federal Highway Administration, U.S. Department of Transportation, Washington, D.C. (July 1984).
- Florida D.O.T., "Report on Use of Private Contractors to Perform Maintenance Activities for the Florida Department of Transportation," Internal Report, Florida Department of Transportation (February 1982).
- Hyser, J. D., "Contract Rest Area Maintenance," paper presented at 58th Annual Meeting, American Association of State Highway Officials, Subcommittee on Maintenance, Washington, D.C. (December 1972).
- Jorgenson, R. and J. C. Whitman, "Problem Solving—Key to Successful Contracting for Maintenance," presentation at the Transportation Research Board 62nd Annual Meeting, Washington, D.C. (January 17-21, 1983).
- Kansas D.O.T., Preliminary Report of Contract Maintenance, Kansas Department of Transportation, Topeka, Kansas (January 1983).
- Kelley, J. F., "Contract Mowing," paper presented to Association of Highway Officials, North Atlantic States (May 1973).
- Lisle F. N., "Contractor Assistance in Highway Maintenance: State-of-the-Art Evaluation," Virginia Highway and Transportation Research Council (August 1980).
- Ortgies, B. H., "Iowa's Experience in Contract Maintenance," presentation at the Transportation Research Board 62nd Annual Meeting (January 17-21, 1983).
- TRB, *NCHRP Synthesis of Highway Practice 106: Practical Guidelines for Minimizing Tort Liability*, Transportation Research Board, National Research Council, Washington, D.C. (December 1983) 40 pp.

APPENDIX

SUMMARY OF RESPONDENTS AND ACTIVITIES CONTRACTED

	PAVEMENT SEALING	MAINTENANCE OVERLAYS	PATCHING & REPAIR	TEMPORARY REPAIR	JOINT REPAIR	CRACK SEALING	SLAB JACKING	SHOULDER MAINTENANCE	SIDEWALK REPAIR	EMERGENCY REPAIR	HEATER PLANNING & SCARIFICATION
Alabama	■	■									
Alaska	○	■								■	
Arizona		■				●					■
Arkansas					○						
California	□	●	□						○	○	
Colorado		○		○			○		○		
Connecticut		■				■					■
Delaware	○	■	□					○	■	○	■
Florida		○	○								
Georgia		●			●						●
Idaho	●	○									
Illinois		□									
Indiana	■	■					■				■
Iowa	■	□	■		□	□		○			
Kansas	■	■	□		●	○		○			
Kentucky		■	○			■					
Louisiana		■									
Maine		□									
Maryland	●	●									
Massachusetts	■	■			■	□		□	□		■
Michigan			○								■
Minnesota	●	○									
Mississippi		●									
Missouri	○	■									
Montana											
Nebraska	○	■	○		●					●	○
Nevada											
New Hampshire		■									
New Jersey	■	●									■
New Mexico	●	○	○			□	■				■
New York										●	■
North Carolina		●									
North Dakota	□									□	
Ohio	■	■	○		●	○		□			
Oklahoma	●	●			■	●	□	○			
Oregon	□	■					■			○	
Pennsylvania	●	■	●	○	■	○	■	○			
South Carolina		■									■
South Dakota	●	○	□	○							
Tennessee					■		■				
Texas	□	○	○		○		■			□	□
Utah	○						■				□
Vermont		□									
Virginia	■	□	○					○	■		
Washington	●	■	○							●	
West Virginia		○	●	●							
Wisconsin	○	○			○			○		□	
Wyoming		■					■				
District of Columbia		■	■	●					■		
Alberta		○									
New Brunswick				●		■					
Nova Scotia		□	□			□					■
Ontario	■	■				□					■
Saskatchewan	□	○	○	□							■
Baltimore, MD		○									
Buffalo, NY		●							●		●
Jacksonville, FL		■									
Kansas City, MO	■	■				■			■		
Madison, WI	■	■	○				■		■	□	■
Portland, OR		○									
Raleigh, NC											
Seattle, WA									●		●
Baltimore Co., MD		□							□		
Greene Co., IA		■					■				
Hennepin Co., MA		■									
Jefferson Co., AL		○									
Montgomery Co., MD		■							□		
Oakland Co., MI		■									
Prince Georges Co., MD		■							□		
San Diego Co., CA	○	●							■		
Wayne Co., MI											■
New Jersey Turnpike											

PAVEMENT MAINTENANCE ACTIVITIES CONTRACTED

LEGEND:

- 90% or GREATER of ACTIVITY CONTRACTED
- 50% to 89% of ACTIVITY CONTRACTED
- 25% to 49% of ACTIVITY CONTRACTED
- 1% to 24% of ACTIVITY CONTRACTED
- ◆ CONTRACTING LEVEL NOT REPORTED

TRAFFIC SERVICES MAINTENANCE ACTIVITIES CONTRACTED

	SIGNAL MAINTENANCE	LIGHTING MAINTENANCE	PAVEMENT MARKING (\$)	PAVEMENT MARKING SYMBOLS	SIGN REPAIR	SIGN CLEANING
Alabama						
Alaska	○	●	○			
Arizona						
Arkansas						
California						
Colorado			○			
Connecticut			●			
Delaware			■	■		
Florida		□				
Georgia						
Hawaii						
Idaho	○					
Illinois	□				○	
Indiana	○	□	○			
Iowa						
Kansas	○	■				
Kentucky						
Louisiana						
Maine		○				
Maryland						
Massachusetts	●	□	●	○	●	□
Michigan	○		○	○		
Minnesota						
Mississippi			○			
Missouri						
Montana						
Nebraska		□				
Nevada						
New Hampshire		■				
New Jersey	●					
New Mexico				■	○	
New York						
North Carolina			●			
North Dakota				○		
Ohio		●	■	○		
Oklahoma			□	□		
Oregon						
Pennsylvania	■	■	○			
Rhode Island						
South Carolina			○			
South Dakota				○	○	
Tennessee			○		○	
Texas	○	○	○	●		
Utah		■			○	
Vermont	○				○	
Virginia			○			
Washington	○	○	○			
West Virginia			●			
Wisconsin						
Wyoming	●					
District of Columbia	■	■				
Puerto Rico						
Alberta		■				
New Brunswick			○			
Nova Scotia					■	
Ontario						
Saskatchewan		●				
Baltimore, MD						
Buffalo, NY		●				
Jacksonville, FL			□			
Kansas City, MO						
Madison, WI			○	○		
Miami, FL						
Portland, OR						
Raleigh, NC						
Seattle, WA						
Baltimore Co., MD						
Greene Co., IA						
Hennepin Co., MA						
Jefferson Co., AL			○		○	
Montgomery Co., MD			○			
Oakland Co., MI						
Prince Georges Co., MD			■			
San Diego Co., CA	■					
Washington Co., TN						
Wayne Co., MI						
New Jersey Turnpike		○				

LEGEND:

- 90% or GREATER of ACTIVITY CONTRACTED
- 50% to 89% of ACTIVITY CONTRACTED
- 25% to 49% of ACTIVITY CONTRACTED
- 1% to 24% of ACTIVITY CONTRACTED
- ◆ CONTRACTING LEVEL NOT REPORTED

BRIDGE & DRAINAGE MAINTENANCE ACTIVITIES CONTRACTED

	BRIDGE OPERATIONS	BRIDGE PAINTING	BRIDGE REPAIR	CULVERT CLEANING	SEWER CLEANING	ROADSIDE & OUTFALL DITCHES														
Alabama		■																		
Alaska		□	□																	
Arizona		■	●																	
Arkansas	●	■																		
California		○	○																	
Colorado		□																		
Connecticut		■																		
Delaware		■	□																	
Florida	○	■	□								○									
Georgia		●	●																	
Hawaii																				
Idaho		○																		
Illinois		■																		
Indiana		■	□																	
Iowa		■	○																	
Kansas		■	□																	
Kentucky		■	■																	
Louisiana		□	○																	
Maine		○																		
Maryland		■	●																	
Massachusetts	○	■	□		○	□	○													
Michigan		■	○		○		○													
Minnesota		■	●																	
Mississippi		■	□																	
Missouri		□	○																	
Montana		●	●																	
Nebraska		○	□																	
Nevada																				
New Hampshire		○																		
New Jersey		■																		
New Mexico					○															
New York		□	●																	
North Carolina		●									●									
North Dakota		■																		
Ohio		■	□						○	■	○									
Oklahoma		■	●																	
Oregon		■																		
Pennsylvania		■	□						○		○									
Rhode Island																				
South Carolina		■	○																	
South Dakota		○	□																	
Tennessee		■	○																	
Texas		□	○						○		○									
Utah		■																		
Vermont		■	○																	
Virginia		■	□																	
Washington	○	■	■						○											
West Virginia																				
Wisconsin		□	□																	
Wyoming		■	■																	
District of Columbia		■									■									
Puerto Rico																				
Alberta																				
New Brunswick																				
Nova Scotia			□																	
Ontario		■	○						○	○										
Saskatchewan		□	○																	
Baltimore, MD		○	○																	
Buffalo, NY																				
Jacksonville, FL										○										
Kansas City, MO		■	■						■											
Madison, WI		■	■																	
Miami, FL																				
Portland, OR																				
Raleigh, NC																				
Seattle, WA		■	○								○									
Baltimore Co., MD			□																	
Greene Co., IA			○																	
Hennepin Co., MA																				
Jefferson Co., AL																				
Montgomery Co., MD																				
Oakland Co., MI										○										
Prince Georges Co., MD																				
San Diego Co., CA																				
Washington Co., TN																				
Wayne Co., MI																				
New Jersey Turnpike																				

LEGEND:

- 90% or GREATER of ACTIVITY CONTRACTED
- 50% to 89% of ACTIVITY CONTRACTED
- 25% to 49% of ACTIVITY CONTRACTED
- 1% to 24% of ACTIVITY CONTRACTED
- CONTRACTING LEVEL NOT REPORTED

OTHER MAINTENANCE ACTIVITIES CONTRACTED

	SAND OR DEICING CHEMICAL APPLICATION	SNOW & ICE REMOVAL	GUARDRAIL REPAIR	ATTENUATOR REPAIR	MATERIAL SUPPLY	MANAGEMENT ACTIVITIES
Alabama						
Alaska		○			○	
Arizona						
Arkansas					■	
California						
Colorado		○				
Connecticut						
Delaware		○			■	
Florida						
Georgia						
Hawaii						
Idaho						
Illinois		○	○			
Indiana						
Iowa					■	
Kansas		○	○		■	
Kentucky			○			
Louisiana						
Maine		○	○			
Maryland			●			
Massachusetts	□	□	■			
Michigan		○			●	
Minnesota						
Mississippi						
Missouri						
Montana						
Nebraska						
Nevada						
New Hampshire		●	□	■	■	●
New Jersey	○	■	○	■	○	●
New Mexico					●	
New York					●	
North Carolina						
North Dakota						
Ohio			□	□		
Oklahoma						
Oregon					□	
Pennsylvania	○		○	□		
Rhode Island						
South Carolina						
South Dakota		○	□			
Tennessee						
Texas			●		■	
Utah		○			■	
Vermont		○				
Virginia			□			
Washington		○			■	
West Virginia						
Wisconsin						
Wyoming		○			■	
District of Columbia	●	□	□			
Puerto Rico						
Alberta						
New Brunswick						○
Nova Scotia						
Ontario	●	●			■	
Saskatchewan					■	
Baltimore, MD		○	□			
Buffalo, NY						
Jacksonville, FL						
Kansas City, MO						
Madison, WI		●				
Miami, FL						
Portland, OR					■	
Raleigh, NC						
Seattle, WA						
Baltimore Co., MD					●	
Greene Co., IA					□	
Hennepin Co., MA					■	
Jefferson Co., AL						
Montgomery Co., MD						
Oakland Co., MI					■	
Prince Georges Co., MD		●				
San Diego Co., CA						
Washington Co., TN						
Wayne Co., MI						
New Jersey Turnpike						

LEGEND:

- 90% or GREATER of ACTIVITY CONTRACTED
- 50% to 89% of ACTIVITY CONTRACTED
- 25% to 49% of ACTIVITY CONTRACTED
- 1% to 24% of ACTIVITY CONTRACTED
- ◆ CONTRACTING LEVEL NOT REPORTED

THE TRANSPORTATION RESEARCH BOARD is an agency of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's purpose is to stimulate research concerning the nature and performance of transportation systems, to disseminate information that the research produces, and to encourage the application of appropriate research findings. The Board's program is carried out by more than 270 committees, task forces, and panels composed of more than 3,300 administrators, engineers, social scientists, attorneys, educators, and others concerned with transportation; they serve without compensation. The program is supported by state transportation and highway departments, the modal administrations of the U.S. Department of Transportation, the Association of American Railroads, the National Highway Traffic Safety Administration, and other organizations and individuals interested in the development of transportation.

The National Research Council was established by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and of advising the Federal Government. The Council operates in accordance with general policies determined by the Academy under the authority of its congressional charter of 1863, which establishes the Academy as a private, nonprofit, self-governing membership corporation. The Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in the conduct of their services to the government, the public, and the scientific and engineering communities. It is administered jointly by both Academies and the Institute of Medicine.

The National Academy of Sciences was established in 1863 by Act of Congress as a private, nonprofit, self-governing membership corporation for the furtherance of science and technology, required to advise the Federal Government upon request within its fields of competence. Under its corporate charter the Academy established the National Research Council in 1916, the National Academy of Engineering in 1964, and the Institute of Medicine in 1970.

TRANSPORTATION RESEARCH BOARD

National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

ADDRESS CORRECTION REQUESTED

NON-PROFIT ORG.
U.S. POSTAGE
PAID
WASHINGTON, D.C.
PERMIT NO. 8970

000015M003
MATERIALS ENGR
IDAHO TRANS DEPT DIV OF HWYS
P O BOX 7129
BOISE ID 83707