

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP Report 366

**Guidelines for Effective
Maintenance-Budgeting Strategies**

**Transportation Research Board
National Research Council**

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Report 366

Guidelines for Effective Maintenance-Budgeting Strategies

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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 insurance 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 the 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.

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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, U.S. Department of Transportation.

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FOREWORD

*By Staff
Transportation Research
Board*

This report contains guidelines for improved maintenance budgeting in areas pertaining to the overall budgeting process, information and management systems, and communication. These guidelines should help state highway and transportation agencies' and other highway organizations' personnel in improving their capabilities to secure funds needed to adequately maintain their highway systems. The report will be of interest to chief administrative officers (CAOs), maintenance managers, agency budget officials, and other agency personnel responsible for developing highway maintenance budgets.

Continuing concerns about the condition of the infrastructure in the United States and the ability to maintain it in an acceptable fashion suggest that funding levels have not been adequate for maintenance. Presenting effective communication of budget requests to decision makers is a key element of the budgeting process and can help to justify the need for funding highway-maintenance operations at levels that will preserve investment in the highway system, reduce long-term replacement and user costs, and provide acceptable service. Therefore, guidelines are needed to facilitate recognition of maintenance needs and to aid maintenance managers in developing effective maintenance-budgeting strategies.

Under NCHRP Project 14-9(1), "Effective Maintenance Budget Strategies," The Urban Institute was assigned the task of identifying the state of the practice in formulating and justifying state highway maintenance budgets and developing guidelines for conveying maintenance budget requests to CAOs, highway and transportation commissions, and legislative bodies. As a result of this project, detailed guidelines for maintenance-budgeting improvements have been developed in areas pertaining to (1) the overall budgeting process, (2) information and management systems, and (3) communication. These guidelines have been developed with consideration given to the role of highway maintenance in integrated management systems and the importance of maintenance as stipulated in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. To facilitate the use of these guidelines, the actions or steps necessary to achieve the objective of each of the proposed guidelines are described. In addition, the guidelines are accompanied by examples of how agencies have successfully addressed the major elements of effective maintenance-budgeting strategies.

As part of this project, a summary of information furnished by state highway and transportation agencies on current and emerging techniques used in highway maintenance and budgeting has been compiled. Also, a review of analytical methods and management systems, which can effectively support the budgeting process, and an analysis of the key elements of effective maintenance-budgeting-strategies development have been completed. This information has not been published herein. For a limited time, copies of the report containing this information will be available on a loan basis or for purchase (\$10.00) on request to NCHRP, Transportation Research Board, Box 289, Washington, D.C. 20055.

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The principal investigator for the project was Arlee T. Reno, initially with The Urban Institute and currently Vice President, Cambridge Systematics, Inc. Co-principal investigators were M. Ed Shaw, President, Bergstralh-Shaw-Newman, Inc. and William A. Hyman, Director, Transportation Studies Program, The Urban Institute.

Thirty-seven state highway and transportation chief administrative

officers provided invaluable insights through their completion of survey forms early in the research. Forty-five state maintenance engineers completed detailed questionnaires that provided in-depth information on current and emerging techniques used in highway maintenance management and budgeting. Ten state highway and transportation agencies—California, Florida, Georgia, Idaho, Kentucky, Mississippi, North Carolina, Pennsylvania, Texas, and Virginia—hosted 2-day or 3-day on-site interviews that provided opportunities to discuss practices, issues, and emerging developments in depth. The input of all participating state highway and transportation agencies, as well as those of the NCHRP panel, are gratefully acknowledged.

GUIDELINES FOR EFFECTIVE MAINTENANCE-BUDGETING STRATEGIES

SUMMARY

The present condition of highway infrastructure in many parts of the United States is testimony that funding levels have not been adequate for maintenance. Effective communication of budget requests to chief administrative officers (CAOs), highway and transportation commissions, and legislative bodies is a key to funding highway maintenance operations at levels that will preserve investment in the highway system, minimize long-term replacement and user costs, and provide user services. However, many state highway agencies have not been successful in communicating such maintenance needs. This may be due to a number of factors, including consideration that benefits from maintenance operations are much less immediately visible to the public than those from construction, and the apparent inability of maintenance managers to convey to executive and legislative bodies the quantifiable benefits of adequate maintenance funding. This report is directed at finding ways to develop, communicate, and realize the levels of funding needed to maintain U.S. highways. The report is presented in two volumes. Volume 1, covering the research approach (findings, interpretations, appraisals, applications, conclusions, and suggested additional research) is not published herein. This report presents Volume 2, which summarizes Volume 1 and contains the guidelines developed to assist government transportation and highway agencies to secure the levels of funding needed to adequately maintain and preserve their highway systems.

The conclusions of this research project are as follows:

- Effective maintenance-budgeting processes require consistent, comprehensive, but flexible strategies.
- The strategy must establish and maintain internal and external maintenance-budgeting credibility, and foster internal and external cooperation.
- The budget strategy should be based on an understanding of what has worked well in the past.
- The strategy must deal with change, develop means for overcoming threats, and respond to improvement opportunities.
- State legislatures and administrations generally have prescribed state-level budget formats and reporting procedures that apply to all state programs. Formal maintenance budget submissions will be in that format rather than in those produced through DOT management systems.

- DOTs/state highway agencies may have little opportunity, in the formal process, to include the types of information that they would judge to be most helpful to maintenance budget decision making.
- An effective strategy has to include extensive and proactive communication outside of the normal budget submission process.
- Supplemental information can be presented in many formats—special studies, reports, meetings, briefings, phone calls, letters, several audiovisual formats, and informal presentations.
- Many specific elements of effective maintenance budget strategies are being used in various states and are contributing significantly to the effectiveness of budget strategies.
- Existing management systems provide a wealth of useful information for the maintenance-budgeting process.
- ISTEA interim and final rules for management systems require elements that will be extremely useful for enhancing maintenance-budgeting information and analyses, particularly from bridge- and pavement-management system enhancements.
- Implementation of the recommendations of NCHRP Project 14-9(4) (*NCHRP Report 363*, “Role of Highway Maintenance in Integrated Management Systems”) will provide for more idealized maintenance management systems that reduce agency and user costs for maintenance activities and programs.

These conclusions led to the development of 23 guidelines—detailed in this report—that are critical to the processes of establishing and maintaining effective highway maintenance-budgeting strategies. The guidelines include examples of effective practices and descriptions of what needs to be done in their implementation.

These guidelines also describe what would be done and how it would be done by knowledgeable and effective CAOs and maintenance engineers. Targeted at CAOs, maintenance managers, and agency budget officials, the guidelines are presented in three chapters. Guidelines for the overall maintenance budget process are presented in Chapter 2, guidelines for the effective use of information and management systems are in Chapter 3, and those for communication are presented in Chapter 4.

The guidelines are not meant to be separable. The researchers do not believe that effective practice can be achieved by ignoring any aspect of them. An effective maintenance budget strategy will include consideration of all the elements of the guidelines. However, specific agencies may need to apply only portions of the guidelines if they are already practicing some aspects of the recommended strategic maintenance-budgeting process. Each of the proposed guidelines is presented, and the actions or steps necessary to achieve guideline objectives are explained. The guidelines have been numbered for discussion purposes only; the numbering does not indicate any implied priority.

The guidelines are accompanied by figures that provide examples of how successful agencies have addressed the major elements of effective maintenance budget strategies. To the extent possible, examples from a selected successful agency are presented in a continuous and integrated fashion. This is not because the best practice comes from only one state, but rather because effective maintenance budget practice is best illustrated through one consistent example.

CHAPTER 1

BACKGROUND

There is continuing national concern about the condition of the infrastructure in the United States, and about the ability to maintain it in an acceptable fashion. Research undertaken through NCHRP Project 14-9(1), "Effective Maintenance Budget Strategies," addresses these concerns. The research results are reported in two volumes. Volume 1, covering the research approach, survey questionnaires, findings, interpretations, appraisals, applications, conclusions, and suggested additional research, is not published herein. This report summarizes Volume 1 and presents the guidelines developed to assist government transportation and highway agencies to secure the levels of funding needed to adequately maintain and preserve their highway systems.

OBJECTIVES

This project was completed in two phases. The objectives of the first phase were to (1) identify the state of the practice in formulating and justifying state highway maintenance budgets; (2) assess the strategic usefulness of various approaches to achieve funding levels consistent with preserving and operating the highway system at acceptable standards; and (3) develop effective guidelines for conveying maintenance budget requests to chief administrative officers (CAOs), highway and transportation commissions, and legislative bodies. The objective of the second phase was to integrate major developments of maintenance-budgeting significance that emerged during or shortly after the completion of the first phase. These developments included (1) passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), and subsequent rule making; and (2) completion of related NCHRP maintenance research projects (i.e., the NCHRP Project 14-9 series).

SCOPE

Research undertaken targeted highway maintenance budgeting and funding strategies at the state level. However, findings and guidelines will be of value, if appropriately modified to local conditions, for all government highway and transportation agencies, and are also relevant to securing funds for the maintenance of nonhighway facilities.

The approach used in completing these tasks included the design and distribution of written surveys to key officials, analyses of survey results, identification of trends in maintenance-funding levels and condition ratings by state, the conduct of on-site interviews with 10 states, library searches, the development

of a synthesis of findings, and the development of the guidelines for effective maintenance budgeting.

Written Surveys

Surveys to elicit information about current budget practices, the effectiveness of these practices, and suggested improvements were sent separately to each of the following key officials in the 50 states and the District of Columbia:

- State DOT/Highway CAOs
- State DOT/Highway Maintenance Engineers
- State DOT/Highway Budget Officials
- Governor's Offices
- Legislature's Transportation Committees

All questionnaires were designed to minimize response time while ensuring that needed information would be collected. Other basic design criteria included the following:

- Establishing close coordination with other maintenance-related research to minimize redundancy and encourage high response rates;
- Supplementing rather than duplicating information available from other sources, such as Federal Highway Administration (FHWA) reported expenditure and condition statistics; and
- Structuring the survey to facilitate analyses and summarization.

The CAO survey had 16 questions. Fourteen could be answered with check marks; two required a narrative response.

The questionnaire for the state maintenance engineer was the most detailed. It was divided into four categories. The first, covering the road maintenance budget and program development process, had 17 questions. While space was provided for respondents to add information not covered in the survey, all questions in this category could be answered with check marks. The second category—program, budget, and finance background—had nine questions. Seven could be answered by checking or completing survey blanks. The remaining questions requested an organization chart showing the maintenance budget development and approval structure, and supplemental information describing the maintenance budgetary process and milestone dates. The general comments category had four questions that required narrative responses. The last category, additional information, requested copies of recent budgets and development guidelines.

The transportation budget director survey had only four budgetary effectiveness-oriented questions. Three could be an-

swered by checking blocks; one required a narrative response. The survey of legislative budget offices had two questions, both of which required brief narrative responses.

Copies of the questionnaires used, showing tabulations of responses, are shown in the Appendix to Volume 1 (not published herein).

Interviews

Two sources of information were used in selecting the 10 states for on-site interviews—tabulations and analyses of written survey results, and data from the Highway Statistics series as compiled by the FHWA. The objective was to identify, as nearly as possible from the information at hand, 10 states that were effectively securing the funds needed to provide adequate levels of maintenance, or that appeared to have developed and implemented innovative programming, budgeting, implementation, and communication practices.

Three basic types of highway statistical information were used: indexed expenditures, centerline mileage, and performance serviceability ratings (PSR). The expenditure and mileage information covered 1982 through 1988 (the most recent then available). PSR data were confined to 1983 through 1988 to retain comparability.

Interviews were conducted over a 2- or 3-day period in each state. Maintenance engineers, DOT CAOs, state DOT/highway budget officials, other maintenance and budget personnel, information systems managers, and key outside officials were the interview targets. Documentation was gathered, and suggestions were solicited and discussed for improving maintenance budget strategies and practices.

Library Research

The library research started with electronic searches through EasyLink. The database used was accessed through the engineering directory of science and technology, and then transportation. The following series of key word searches was completed:

- The key words used in the first search, “highway and maintenance and budget” yielded 232 references in TRIS, and 128 references in seven other databases. Abstracts for the 50 most recent references in TRIS were compiled.

- Key words used in the second search through the same menu choices were “highway and maintenance and economic analysis.” This search yielded 118 references in TRIS and 40 in three other databases. Abstracts for the most recent 35 references were compiled.

- Keys words used in the third search were “highway and maintenance and road user cost.” This search, as might be expected, yielded fewer references. Only 13 were shown for TRIS. Eighteen were shown in two other databases. Abstracts for the 13 references in TRIS were compiled.

- Key words used in the third search were “highway and maintenance and safety.” This search yielded over 1,600 references in TRIS, 30 abstracts were compiled.

Copies of promising documents were compiled from the libraries of the research agencies, as well as other agencies and

organizations. In addition, the results of comparable searches done for two other recent NCHRP maintenance projects—14-9(2), “Incorporation of Maintenance Considerations in Highway Design,” and 14-9(3), “Maintenance Contracting,” (published as *NCHRP Reports 349* and *344*, respectively)—were compiled and reviewed.

CONCLUSIONS

Following are major research conclusions with highway maintenance-budgeting strategy implications:

- An effective overall maintenance-budgeting process requires a consistent, comprehensive, but flexible strategy.
- The strategy must be aimed at establishing and maintaining the credibility of maintenance budget proposals and information, and must provide for cooperation among all offices of the DOT/state highway agency, as well as interactions between the DOT and outside groups.
- The maintenance-budgeting strategy should be based on an understanding of what has worked well in the past.
- The strategy must be able to deal with change, and must develop means to overcome threats and respond to opportunities for improvements.
- Although it was anticipated that it might be possible to revise the budget submissions that went from the DOT to the governor’s budget office and the legislature, the state legislatures and administrations generally have prescribed state-level budget formats and reporting procedures, which apply to all state programs. Thus the DOT/state highway agency may have little or no leeway to include—in the prescribed and constrained budget submissions—the types of information that they would judge to be most helpful to improving decisions about maintenance budgeting.
- A strategy for effective maintenance budgeting has to include extensive and proactive communication outside of, and in addition to, the prescribed budget submissions and documentation.
- The information about maintenance can be presented in terms of special studies, reports, meetings, briefings, phone calls, letters, several audiovisual formats, and informal presentations.
- Many specific elements of effective maintenance budget strategies are being used in various states and are contributing significantly to the effectiveness of budget strategies.
- The integration of the effective specific budget elements into an overall strategy and supportive procedures for effective maintenance budgeting can be accomplished by following an integrated set of guidelines for effective maintenance budgeting.
- Guidelines for effective maintenance budget processes can improve decision making about maintenance budgets. The guidelines developed for this project represent the current state of the art in effective maintenance budget strategies.
- These guidelines should be updated periodically to take account of research results, technological advances, and experience gained.

RECOMMENDED GUIDELINES

The guidelines presented herein include the information presented in summary form in Volume 1, plus elaborations, expla-

nations, and examples. The research identified the desirability of including in the guidelines several illustrative examples of effective practice. Although it is intended that the guidelines be brief, they must also provide references to examples of effective practice, which can be emulated easily by other states or agencies. Therefore, there is substantial emphasis on the illustrative "how to" of proven effective procedures. The intent is to have a tool that is useful in all states for making improvements to the maintenance-budgeting process.

Securing a desirable level of funding for highway maintenance is a complex process that requires careful strategic planning early in the budget cycle, and continues to require the application of strategic planning throughout the budget cycle. Because more than one budget cycle is being planned and implemented at a time, it is also a multiyear process. This process requires careful analysis to identify the desirable level of maintenance resources for each activity, superior communications tools, the use of appropriate information summarized from agency management and information systems, and skills in management and personal relations.

An effective overall maintenance budget strategy is a way of shaping the budget development process, involving the right actors at the right time, using the most appropriate information, and taking advantage of opportunities to present the best case for maintenance. The strategy needs to be flexible in terms of responses to particular issues and opportunities.

These guidelines describe what would be done and how it would be done by knowledgeable and effective CAOs and maintenance engineers. Targeted at CAOs, maintenance managers, and agency budget officials, the guidelines are presented in three chapters. Guidelines for the overall maintenance budget process are presented in Chapter 2, guidelines for the effective use of information and management systems are in Chapter 3, and those for communication are presented in Chapter 4.

The guidelines are not meant to be separable. The researchers do not believe that effective practice can be achieved by ignoring any aspect of them. An effective maintenance budget strategy will include consideration of all the elements of the guidelines. However, specific agencies may need to apply only portions of the guidelines if they are already practicing some aspects of the recommended strategic maintenance-budgeting process.

Each of the proposed guidelines is presented, and the actions or steps necessary to achieve guideline objectives are explained. The guidelines have been numbered for discussion purposes only; the numbering does not indicate any implied priority.

The guidelines are accompanied by figures that provide examples of how successful agencies have addressed the major elements of effective maintenance budget strategies. To the extent possible, examples from a selected successful agency are presented in a continuous and integrated fashion. This is not because the best practice comes from only one state, but rather because effective maintenance budget practice is best illustrated through one consistent example.

CHAPTER 2

GUIDELINES FOR THE OVERALL BUDGET PROCESS

Guidelines for improving the overall maintenance-budgeting process are presented in this chapter. The scope of these eight guidelines ranges from documenting the process and ensuring full understanding to identifying budgetary threats and dealing creatively with change.

Guideline One: Document and understand the process, the actors, the issues, and the experience of the past.

The budget process and the agency's experience with it need to be fully understood. Process documentation is the starting point for full understanding. All existing written materials describing the process should be collected and reviewed. In addition, up-to-date discussions of the budget process covering elements not yet described in writing should occur to ensure full documentation. It is helpful for maintenance managers, the CAO, and budget officials to discuss with each of the actors what the outcome of the last budget process was and to identify suggestions for improvements. This is like a debriefing, and helps to develop a common understanding of what has happened with past budgets and why.

The budget process must begin with and build upon a careful and realistic assessment of where the previous budget has taken the maintenance organization itself and the DOT/highway agency as a whole. Taking stock of the previous budget process and outcome is useful to determine what strategy should be pursued for the coming year and those that follow. Taking stock of the past process should address the following:

- Content and level of the last budget;
 - Issues that were addressed successfully in the last budget cycle;
 - Issues that were addressed unsuccessfully or ignored in the last budget cycle;
 - New issues;
 - Revenue trends;
 - Roadway and bridge condition and life-cycle trends;
 - Program cost and magnitude trends;
 - Relationship to capital expenditures, including budgetary tradeoffs and new projects that need to be maintained;
 - Program levels, staff levels, materials needs, and equipment condition and needs;
 - Organizational units affected;
 - Public and political jurisdictions and interests affected;
 - Information used to explain and justify budget requests;
 - Communications and media used;
 - Changes in internal and external leadership and priorities;
- and

- Emerging opportunities and threats.

While it is not necessary that this entire assessment be committed to writing, each of the points should be addressed either formally or informally in the maintenance-budgeting strategic-planning process.

Checklist**What to Do:**

- Review last budget cycle, and
- Interview key actors in the maintenance budget preparation process.

What to Include:

All elements listed previously need to be included in the review and discussed as appropriate with key budgetary decision makers.

Who Should Do It:

- Top maintenance management, and
- Budget staff.

Guideline Two: Create and manage an internal maintenance-budgeting process which is inclusive and well understood.

An explicit overall maintenance budget process should be developed and managed. The process should include the following:

- A structured, documented, and well-understood internal process for developing the proposed budget and supporting materials;
 - Guidance to all responsible units on how to structure, format, and justify budget requests;
 - Assignments of district and other office responsibility for developing initial budget proposals within the context of agency guidance;
- A management process by which budget proposals move up through the organization, with opportunities to present and discuss priorities and proposals for budget adjustments;

- Commitment by top management to the process, including openness to suggestions; and
- Frequent and regular face-to-face management team meetings involving district and headquarters maintenance managers, with exchange of information on outside contacts, budget development and budget monitoring, accomplishments versus goals, status and conditions of the highways and bridges, and issues and prospects.

A structured, documented, and well-understood internal process ensures that all elements of the agency understand their role in the process of developing budget proposals, and provides assurance, if followed, that the budget proposals will be developed and evaluated in a timely manner. Written documentation is used by most agencies to ensure that there is a common understanding of the steps in developing the budget. Documentation should include a schedule, flow chart of information, and explanation of each step and of the responsibility of each office to develop the budget.

Guidance on structuring, formatting, and justifying budget proposals should be provided and distributed to all districts and offices that will prepare initial budget proposals. This ensures that a) budgets will be structured in a desired format from the beginning of the process and b) some of the information that will later be used in external submissions to explain and justify budgets will be developed at an early stage, and later refined.

District- and lower-level responsibilities for developing initial budget submissions within agency guidelines ensures that all field and other offices will have a chance to be heard. They can present their requests and provide analyses and justification. They may have to accept fewer resources than desired, after the overall budget process is completed, but the process will have considered all points of view if lower levels are provided development, justification, and discussion opportunities.

A hierarchical process of budget refinement ensures that all offices and agencies have a chance to review proposals and to express their preferences about priorities within their area of responsibility. An advisory committee of the responsible managers can discuss budget proposals openly and can develop as much consensus as possible. Their points of view can be provided to the CAO for final internal decisions on budget proposals.

Checklist

What to Do:

- Create or modify internal management procedures,
- Involve key staff,
- Hold regular management meetings, and
- Share information.

The development of maintenance budget proposals should be a cooperative process among maintenance management personnel, budget officials at headquarters, and in the districts of an agency. In response to a question of whether the maintenance budget proposals were developed through a top-down or bottom-up approach, several successful agencies answered "both." In these agencies, budget guidelines are typically understood by all parties, and negotiations over what should be proposed are

interactive. The headquarters personnel and the district personnel each present their ideas for how the budget should change from the previous years. Agreement is generally reached before the budget proposal goes to top management, and agreement is always reached before it goes outside the agency.

What to Include:

- A well-structured, documented, and widely understood internal process for developing the proposed budget and supporting materials;
- Guidance to all responsible units on how to structure, format, and justify budget requests;
- Assignments of district and other office responsibility for developing initial budget proposals within the context of agency guidance;
- A management process in which budget proposals move up through the organization, with opportunities to present and discuss priorities and proposals for budget adjustments;
- Commitment by top management to the process, including openness to suggestions; and
- Frequent and regular face-to-face management team meetings involving district and headquarters maintenance managers, with exchange of information on outside contacts, budget development and budget monitoring, accomplishments versus goals, status and conditions of the highways and bridges, and issues and prospects.

Who Should Do It:

- Top management,
- Maintenance management, and
- Districts and/or divisions and/or counties.

Figure 1 documents the internal actors and their assignments of responsibility for the Pennsylvania Department of Transportation's (PennDOT) budgeting process. Documentation of the roles of each leads to a common understanding of how the agency is preparing its strategic plan and budget. While the participation of internal actors is broad and comprehensive, this is unavoidable if the agency is to manage its resources consistently and effectively.

Figure 2 shows the PennDOT budget cycle. The strategic plan for the budget process is widely distributed throughout the agency. The budget process engages all top management in decisions about priorities and resources, and produces an internal budget within a time frame consistent with the overall state budget development process.

Guideline Three: Maintain an internal management process that focuses on agreement, cooperation, and consistency.

The DOT/state highway agency should operate as one team, through a fair and enlightened management process, and with consistent understanding of maintenance issues and priorities. Maintenance budgeting and maintenance management should

The Budget Actors

Given the belief that budget development and implementation are intrinsic parts of program management, PennDOT encourages maximum participation by its managers. Organizations are encouraged to have budget development teams and formal sub-organization hearings. Budget materials (with their strategic planning content) are to be shared and discussed with management and nonmanagement employees as a means of communicating values, priorities, and program direction. Some of the key PennDOT budget committees, organizations, and individuals are

Secretary of Transportation

- Chairs the Strategic Management and Program Management Committees, and provides overall leadership for the integrated strategic management/budget development process.

Strategic Management Committee

- Establishes central policy for the Department, including budget instruction guidelines.

Program Management Committee

- Establishes Department policy on program implementation and project schedules, which is reflected in specific budget targets.

Deputy Secretaries, Other Executive Staff, and District Engineers

- Oversee strategic planning efforts for their organizations.
- Develop budget presentations for the Secretary's Budget Hearings.
- Implement program and budget plans.

Budget Coordinators

- Assist Deputy Secretaries, other Executive Staff, and District Engineers in budget preparation.
- Serve as liaison with their sub-organizations and the Bureau of Fiscal Management to facilitate providing budget information, answering external budget questions, and resolving budget implementation problems.

Bureau for Strategic Planning

- Under the direction of the Deputy Secretary for Planning, supports the activities of the Strategic Management Committee.
- Develops proposed District Four Year Plan/Budget Guidelines for the Strategic Management Committee, and handles plan follow-up.
- Supports the Bureau of Fiscal Management on strategic planning/budget development activities for which it has the lead.

Center for Program Management

- Under the direction of the Deputy Secretary for Planning, supports the activities of the Program Management Committee.
- Develops proposals on program implementation and project schedules for the Program Management Committee.
- Supports the Bureau of Fiscal Management on program management/budget development activities for which it has the lead.

Bureau of Fiscal Management

- Under the direction of the Deputy Secretary for Administration, oversees the Department's budget cycle activities.
- Develops proposed budget instructions for the Strategic Management Committee, and handles budget hearing follow-up.
- Supports the Bureau for Strategic Planning and the Center for Program Management on strategic planning/program management/budget development activities for which they have the lead.

Figure 1. *The budget actors.*

The Budget Cycle

The budget cycle is separated into 10 phases. Each of the first 9 development phases serves as a building block toward actual program implementation in Phase X.

Phase I: Preparatory Steps

The main link between ongoing strategic planning efforts and the annual budget calendar is made by the Strategic Management Committee (SMC) during this phase. SMC establishes program themes and priorities, as well as expenditure and personnel targets, to be specifically addressed for the upcoming fiscal year. A 5-year Motor License Fund Projection (Yellow Book) is developed to highlight short- and long-term revenue and expenditure trends. Proposed initiatives are submitted to the Office of Budget for inclusion in the Governor's Program Policy Guidelines.

Phase II: District Engineer and Executive Staff Budget Preparation

The Secretary issues a Budget Preparation Message, which formally transmits SMC direction to Department managers. These instructions are revised, as appropriate, after receipt of the Commonwealth Budget Instructions and Program Policy Guidelines from the Office of Budget. Final appropriation-specific instructions, including detailed worksheets, are submitted to budget presenters. District Engineers and Executive Staff members prepare for the Secretary's hearings, many conducting similar budget hearings for their sub-organizations.

Phase III: Secretary's Budget Hearings and Decisions

District Engineers and Executive Staff members submit written documents and make their oral budget presentations. The Deputy Secretary for Administration prepares a package of issues and options based on discussions at the hearings. The Secretary and Deputies make final decisions on funding levels, personnel levels, and new initiatives. Budget presenters prepare revised or additional information on new initiatives as required.

Phase IV: Submission of PennDOT's Budget

The operating budget request, with supporting forms and justification as well as a Department Policy Statement, is prepared by the Bureau of Fiscal Management and submitted to the Office of Budget. A capital budget request is prepared by the Center for Program Management and submitted to the Office of Budget.

Phase V: Governor's Office Review

The Secretary and other Department staff meet with the Office of Budget to discuss specific request items and preliminary Office of Budget recommendations. A briefing package is prepared for the Secretary, who meets with the Governor to discuss major program policy and funding issues.

Phase VI: Submission of Governor's Budget

Department staff assists the Office of Budget in making adjustments to reflect the decisions of the Governor and the Budget Secretary. The Governor formally submits the Commonwealth Budget to a joint session of the General Assembly.

Phase VII: Legislative Hearings and Deliberations

The Bureau of Fiscal Management prepares a Legislative Hearings Package in conformance with instructions issued by the Appropriations Committees. A Budget Request Highlights booklet is prepared for the Deputy Secretary and other Department staff to meet with the Appropriations and Transportation Committee staff. Executive Staff members and the Bureau of Fiscal Management provide the Secretary with background materials, and the Secretary testifies before the House and Senate Appropriations Committees. Department staff responds to committee inquiries as the legislature proceeds with its budget deliberations.

Figure 2. *The budget cycle.*

The Budget Cycle (cont.)

Phase VIII: Preliminary Rebudget

District, County, and Central Office organizations prepare preliminary rebudget allocations based on the Governor's Budget.

Phase IX: Budget Enactment and Rebudget

The General Assembly passes legislation to establish appropriation amounts. The Office of Budget issues rebudget instructions, which include updated factors for personnel and other expenditure items. District, County, and Central Office organizations finalize proposed rebudget allocations. The Bureau of Fiscal Management reviews these requests and submits the necessary documents and supporting materials to the Office of Budget.

Phase X: Budget Implementation

Individual organizations implement and monitor their budgets. Program progress made and strategic management issues raised during this budget execution phase are reviewed on an ongoing basis by the Program Management and Strategic Management Committees. Feedback from program managers helps the SMC refine or modify Department direction when the budget cycle returns to Phase I.

Figure 2. *The budget cycle (continued)*

be an integral part of agency strategic planning. Whether or not an agency conducts a process which it calls strategic planning, these guidelines are intended to incorporate maintenance budgeting into its overall budgeting and planning process.

Within the state DOT or highway agency, there are a substantial number of actors with influence over the maintenance budget including the following:

- CAO;
- State Highway Engineer (if different from the CAO);
- Director of Operations (or of Operations and Maintenance);
- Director of Maintenance or Maintenance Engineer;
- Maintenance Engineer's staff;
- Budget Office staff of the DOT and/or highway agency;
- District, Division, and/or Area Engineer's and staff;
- Management Information, Systems, or Computer Department;
- Design Department and Design Engineers;
- Bridge Department and Bridge Engineers;
- Maintenance staff;
- Maintenance Employee Representatives;
- Public Affairs;
- Research and Materials;
- Construction; and
- Planning and Programming.

Operating as a team cannot be ensured, but can usually be achieved through internal management coordination and cooperation. It cannot be achieved through coercion of the agency's employees. To achieve coordination and cooperation, there has to be extensive personal consultation and open communication.

PROCEDURES FOR COORDINATION

Successful agencies in regard to this guideline have established procedures for coordination, such as frequent management

meetings, sharing of information, and sharing of responsibility for budget development and budget justification. Management coordination must be both lateral and vertical within the agency. Sharing of responsibility does not imply that there is no hierarchy of decision-making authority within the agency, but that budget proposals and justifications are distilled through the agency within an orderly process.

Successful agencies use regular interaction among headquarters maintenance managers and field personnel to keep all parties aware of both internal and external concerns. Regular procedures for meetings of district and headquarters personnel allow all parties to develop solutions and agreements not only on budget matters but also on other matters. Regular meetings allow an exchange of information on what concerns are being expressed by legislators, local officials, and the public in each part of the state.

It is particularly important that the district and headquarters personnel have a cooperative process of maintenance budget development and maintenance management. Budgets that are simply passed down through the organization, without participation or input from below, will not be managed to achieve the agency's goals, but will be managed to show compliance with the directed amounts of expenditures. In contrast, budgets that everyone understands are managed at each level to achieve the agency's goals and priorities under the constraints of actual circumstances.

PARTNERSHIPS

As expressed in the PennDOT's rule, "An effective budget process must have cooperation among program, policy, and budget organizations—and establish a partnership among field and central office support staff."⁽¹⁾ Agreement on priorities within the agency depends on interaction among top management and all other divisions of the agency. For maintenance, this also

means that interaction must occur and agreement must be developed among field personnel and headquarters personnel. Agencies with effective management integration will have a major advantage in developing an integrated and effective maintenance budget strategy.

Some successful agencies bring together all field managers and headquarters personnel into 2-day management meetings every 1 or 2 months. Others have less frequent general meetings, sometimes tied to budget development, and rely on task forces and regular field visits by headquarters staff. One successful agency uses teleconferencing to get all district and headquarters personnel to discuss issues without traveling so extensively.

Other key internal actors in the budget process are likely to be the agency's internal budget officials, those responsible for management systems (maintenance management systems, pavement management systems, bridge management systems and others), the planning and programming unit or units, and the design, construction, and administrative units.

Commitment of Top Management

Commitment by top management to the budget development process is essential. If top management does not allow any key element of the approach to influence the budget, credibility of the budget process may be undermined and damage the effectiveness of the overall process. As PennDOT states its rule for commitment, "An effective budget process must have the ongoing commitment of top management, which must demonstrate that the process is a policy-making system that recognizes individual managers as responsible and accountable."⁽²⁾ Without commitment from top management, any participatory budget process will break down because managers always know when their input is not being considered.

All top management must interact frequently enough to have a common understanding, and must exchange information about outside contacts and about the concerns of those outside the agency. A budget strategy must be intricately tied to a management strategy, through which agency management coordinates its internal and external activities. All top-management officials should have a common understanding of the principal maintenance issues and maintenance budget decisions.

All top management is likely to interact in some important way with the legislators, elected officials, and the public. All top management should place before the legislators and the public a consistent picture of maintenance concerns, issues, performance, and future requirements. Presenting a consistent picture will require a strong program of internal communication and coordination.

Checklist

What to Do:

- Provide regular internal communication, especially management team meetings; and
- Maintain agreement on maintenance issues, priorities, and directions.

Highlights of North Carolina DOT Coordination Procedures

- Monthly operations staff meeting of 14 division engineers and 14 other key staff, for 1½ days each month, to address budget issues as well as other operations.
- Standing operations advisory committee of 4 field division engineers and 3 central office engineers, with rotating membership, to address issues that were not resolved at the monthly meetings.
- Five maintenance conferences in 2 years to bring in all division, county, and maintenance engineers, to develop the maintenance story and agreement on it.
- "Singing the same tune" about maintenance needs.
- Exchange of all information from divisions and headquarters about legislative and other contacts.
- Well-designed, brief, to-the-point presentations to legislators and others on key issues.
- Solicitation of requests from Divisions of special needs to include in next budget.

Figure 3. Highlights of North Carolina DOT coordination procedures.

What to Include:

- Procedures for coordination,
- Partnerships, and
- Top management commitment.

Who Should Do It:

- Maintenance management,
- Divisions or districts, and
- Top management.

Figure 3 describes the procedures utilized by North Carolina DOT to ensure internal coordination, with a focus on the maintenance and budgetary aspects of the coordination procedures.

Figure 4 shows the calendar through which PennDOT schedules the budgeting activities throughout the development cycle. A schedule of this type can be an important element in maintaining a coordinated process focusing not only on timely com-

Proposed 1989-1990 PennDOT Budget Calendar		
<u>Time Span</u>	<u>Participants</u>	<u>Subject Matter</u>
Nov/Feb	Strategic Planning Strategic Planning/Fiscal Management/Budget Coordinators	Summarize prior 4-year plan/budget issues. Review prior year 4-year plan/budget process.
Mar/Apr	Strategic Planning Strategic Planning/Fiscal Management/Budget Coordinators	Develop draft instructions for district 4-year plans/budgets Conduct district 4-year plan/budget workshop
May	Strategic Management Committee	Review and approve final district 4-year plan/budget process instructions.
June	Secretary	Issue budget preparation process memo to executive staff and district engineers including <ul style="list-style-type: none"> • Major themes • Budget calendar • Hearings schedule
	Fiscal Management	Prepare 5-year MLF (revenue and expenditure) projections for submission to Deputy Secretary for Administration Develop and submit to Deputy Secretary for Administration <ul style="list-style-type: none"> • Preliminary budget year revenue estimates • Preliminary budget year complement levels (by organization/appropriation) • Preliminary internal program level guidelines
June 28-30	Secretary/Executive Staff/ Central Office, District and County Managers	Discuss priorities and options for Department programs at PennDot Management Conference

Figure 4. Proposed 1989-1990 PennDOT budget calendar.

pletions but also on opportunities to attain agreement, cooperation, and consistency.

Guideline Four: Identify key outside actors and create and maintain relationships and credibility with external decision makers.

Important actors from outside the DOT or highway agency include the following:

- State Legislature and Committee members and staff;
- State Transportation or Highway Commission, Committee members, and staff (if any);
- Governor and the Governor's direct staff;
- State Budget Officer and staff;

- Local elected officials and staff;
- Interest groups;
- The public at large;
- Congress and Committee members and staff;
- DOT and the FHWA; and
- The media (newspapers, TV, radio, etc.).

The DOT/state highway agency should develop a comprehensive approach to communicating consistently and objectively with all external groups, including the legislature and governor's budget office. Good relationships with outside decision makers cannot be achieved without establishing the credibility of the agency, of its budget development and decision processes, and of maintenance itself as an activity of the agency.

Proposed 1989-1990 PennDOT Budget Calendar (cont.)

<u>Time Span</u>	<u>Participants</u>	<u>Subject Matter</u>
July	Strategic Management Committee	Review and approve recommendations for Secretary's budget preparation message.
	Secretary	Issue budget preparation message to executive staff and district engineers with budget year guidelines/priorities <ul style="list-style-type: none"> • Major program priorities for 1989-1990 • Complement levels by organization • Appropriation levels including estimated augmentations • PRR guidelines • Inclusion of special items (such as EDP, employee involvement, and safety) • Special cost considerations/limitations (such as overtime, equipment acquisition)
August	Deputies and Staff/ District Engineers and Staff/Budget Preparation Committees	Internal Deputy and District Engineer budget hearings.
	Budget Preparation Committees/Fiscal Management	Provide assistance to the executive staff in formulating their individual budget proposals.
	Fiscal Management	Transmit updated instructions to the executive staff/district engineers per Governor's budget instructions and program policy guidelines.
September 1	District Engineers	Submit technical budget packages to Deputy Secretary for Highway Administration for hearings scheduled for September 14-16.
	District Engineers	Submit EDP information to Bureau of Information Systems, and training plan to Bureau of Personnel.
September	Executive Staff	Submit technical budget packages to fiscal management 3 working days prior to hearing date.
September 19-30	Executive Staff/District Engineers	Present proposed budgets—including PRR proposals (if applicable).
October 3-5	Secretary/Deputy for Executive Staff/Fiscal Management/Strategic Planning	Review budget issues, discuss policy implications, and finalize budget decisions.

Figure 4. Proposed 1989-1990 PennDOT budget calendar (continued)

The maintenance-budgeting strategy must include a strategy for developing and fostering relationships among each of the outside and inside groups, and the highway agency's top management and maintenance organization. Successful agencies have a strong orientation to meet frequently with legislators and the governor's budget officials, and to interact frequently with local officials, the public, and interest groups. Only through frequent contacts will top management and maintenance management ensure that they understand the current concerns of the public and of decision makers. Only through fairly frequent

contacts will those outside persons gain an understanding of maintenance and other programs or of factors affecting maintenance costs or conditions of the roads.

Assignments of responsibility for outside contact can be as extensive as the internal management capability allows. The ability of the agency to manage positive outside contacts will depend critically on the internal degree of consistency that is established as a result of internal management procedures. Even the best and most energetic of CAOs cannot handle all outside contacts. For example, district- or county-level employees of the

Proposed 1989-1990 PennDOT Budget Calendar (cont.)		
<u>Time Span</u>	<u>Participants</u>	<u>Subject Matter</u>
October	Fiscal Management	Make budget adjustments, consolidate budget proposals, and prepare budget forms.
October 31	Fiscal Management	Submit department budget request to Office of the Budget.

Figure 4. Proposed 1989-1990 PennDOT budget calendar (continued)

agency are more likely to have extensive day-to-day contacts because that is where the resources are located.

Local elected officials and local legislative representatives generally deal directly with division or district managers. Building up these local one-on-one relationships is a major means to achieve overall understanding as well as to address local issues.

An effective maintenance-budgeting strategy with regard to relationships and communications with key officials, other outside groups, and the public will include

- Establishing positive relationships with new legislators and other newly elected officials and their staff;
- Maintaining and nurturing relationships with legislators, elected officials, their staff, interest groups, and the public;
- Internally coordinating the understanding of agency managers on all issues, and communicating a consistent message to all outside groups;
- Monitoring the understanding and concerns that outside groups have of maintenance, maintenance efforts, and road conditions;
- Developing and presenting information that illustrates to outside groups that agency maintenance programs are responsive to their concerns.

Checklist

What to Do:

- Identify actors, and
- Create and maintain credibility.

What to Include:

- Establishing positive relationships with new legislators and other newly elected officials and their staff;
- Maintaining and nurturing relationships with legislators, elected officials, their staff, interest groups, and the public;
- Internally coordinating the understanding of agency managers on all issues, and communicating a consistent message to all outside groups;
- Monitoring the understanding and concerns that outside groups have of maintenance, maintenance efforts, and road condition; and

- Developing and presenting information that illustrates to outside groups that agency maintenance programs are responsive to their concerns.

Who Should Do It:

- Top management,
- Maintenance management, and
- Public relations/Legislature liaisons.

Figure 5 shows advice from the CAO survey on establishing and maintaining legislative relationships.

Guideline Five: Take the initiative to establish positive relationships with new key decision makers and their staff, and maintain positive relationships with those who continue in their positions.

The steps to establishing positive relationships are straightforward. Personal contacts should be made by agency top management. All staff should respond politely and helpfully to all inquiries.

Top management and all appropriate staff should establish new working relationships with newly elected or appointed decision makers and their staff. The likelihood of regular turnover among governors and gubernatorial staff, the DOT's top leadership and staff, and legislators and local officials and their staff, means that there will always be a need to take the initiative in establishing new working relationships.

The importance of introductory meetings and interactions is substantial. Although the agency may have a very positive image throughout the state, new key decision makers may start with less understanding of the agency's mission and budgetary needs, or they may have a desire to make a mark on decisions. They may start with little or no concept of or interest in important activities such as highway maintenance. For activities such as maintenance—which may not have been subject to much press coverage, and which may seem less glamorous than new initiatives—bringing new actors along the learning curve may require special attention if those new decision makers are to understand the key importance of maintenance to the state.

A survey of AASHTO member departments conducted by the Arizona DOT in 1992 found that 63 percent of DOTs met one-

CAO Survey Advice on Legislative Relationships

Know your legislative bodies and oversight committees. Clearly articulate funding needs and consequences of deferred maintenance. Quantify reductions in future capital rehabilitation costs.

Be straightforward with legislators concerning the results of increased spending. Provide legislators with information concerning the effect of increased funds to their constituents.

Convene a task force and include all affected parties. This allows everyone to clearly understand the program and the overall goals. . . . The lobbying effort becomes much easier because much of the work has been done prior to the legislative session.

Convince others that properly maintained highways cost less in the long term.

Demonstrate the benefits to the traveling public, and work with the legislature to establish maintenance as the number-one priority in investing transportation resources. This can be sold on the basis of the . . . investment and replacement cost of the . . . system.

Every approach must be tailored to the individuals being dealt with and be in concert with the times and conditions.

Have state statutes written to provide priority funding for maintenance versus capital improvements.

It is increasingly important to show exactly what the public will receive for any new funds, in terms of tangible products.

Present an accurate and consistent program to meet needs.

Show that with a reasonable level of funding a well-maintained system can and will be in place. Let the quality of maintenance sell the program.

Simply communicate the needs and explain what will be accomplished at the requested funding level. Be prepared to refute some "traditional" complaints. The magnitude of maintenance needs to be communicated.

Tell the story exactly the way it is. Put together good factual past, needed, and projected costs. Show incrementally what 1 cent, 2 cents, 3 cents, etc., will do to increase the level of service.

Establish closer ties with legislative and budget analysts, and appropriations chair. Personal time spent traveling and hands-on demonstration of maintenance problems that exist . . . that the traveling public does not see . . . pay great dividends.

Provide a thorough, in-depth analysis of needs. Credibility of outside consultant may be appropriate.

There is a history of strong legislative support for maintenance and construction. Contacts and responsiveness help to convince legislatures that the job gets done and done well.

Work with legislators. Avoid confrontations.

Figure 5. CAO survey advice on legislative relationships.

on-one with each new legislator, 26 percent scheduled an informal meeting with all new legislators, 20 percent scheduled formal meetings with all new legislators, 30 percent sent literature, and 30 percent used other contacts. (The total percentages add to over 100 percent because many used multiple means of interacting with new legislators.) The survey concluded that face-to-face meetings were the most effective means of communicating with new legislators.

Checklist

What to Do:

- Initiate contacts, and
- Meet face to face.

What to Include:

- Explanations of agency goals and objectives, and of its programs;

- Information on maintenance expenditures, conditions, performance quantity, and quality; and
- Geographic breakdowns.

Who Should Do It:

- Top management,
- Maintenance managers,
- Divisions or districts, and
- Budget staff.

Guideline Six: Design maintenance and rehabilitation programs that respond to the concerns of the public and decision makers, and emphasize that they are stakeholders.

Successful agencies have designed and implemented their maintenance and rehabilitation programs around issues that concern the public. The California Department of Transportation (Caltrans), for example, programs maintenance and rehabilita-

CAO Survey Advice on Building Constituencies

Organize constituency groups. Prepare a clear program of what is needed to achieve an agreed upon set of goals. Make funding requests reasonable in view of the state's fiscal situation.

Secure the support of interest groups: contractors, truckers, the American Automobile Association, highway users, etc., well ahead of any proposals.

Build strong transportation alliances.

Figure 6. CAO survey advice on building constituencies.

tion funds so as to reduce the proportion of the vehicle miles of travel that occur on roads with rough rides. This illustrates to outside decision makers and to the public that the agency is responsive to their issues rather than just to internal concerns.

An agency should seek to demonstrate to all interests that they are stakeholders in maintenance budget decisions. The information that may be helpful in accomplishing this goal is discussed below. Primarily, it is the development of breakdowns of budget, condition, and other information by selected geographic areas. The breakdown by geographic area provides information with which people can readily identify. The geographic breakdown may be by district of the highway agency, or by county. Legislators may be highly interested in localized information as well as in statewide information.

Another action that can be taken to help people and interest groups develop an understanding of the stake they have in maintenance is to formalize the stake. Some states have legislatively determined allocations of some or all state highway maintenance funds to be spent (by the state DOT on state highways) within counties. Local officials and legislators can thus perceive that their county or represented area will directly benefit from setting or keeping maintenance appropriations at a level that ensures better conditions.

Key stakeholders in each state also include those private interests that participate directly in highway maintenance and construction: the paving and construction industries, and other private contractors who perform maintenance tasks. NCHRP Project 14-9(3), for which the research was recently completed, provides a full discussion of the issues involved with contracting versus in-house efforts. For budgeting purposes, maintenance and paving contractors perceive themselves as having a partly cooperative and partly competitive posture regarding the agency. They wish to see the overall maintenance budget increased, but of course prefer that a larger share be devoted to private contractors rather than to state forces.

Figure 6 shows selected advice from CAOs on the issues of establishing constituency groups and stakeholders.

Do not overlook other important constituencies that may be strong allies for the maintenance program. They potentially include environmental organizations promoting preservation over new construction, and taxpayer public interest groups seeking to ensure that public funds are used as wisely as possible. Pursuing the support of these other constituencies should obviously be done without undermining the overall and long-term goals of the Department or those of state government.

Guideline Seven: Identify threats to the maintenance budget and prepare appropriate responses to the threats.

Threats to maintenance budgeting occur for many reasons. The current fiscal difficulties of many of the states relate more to shortages within their general fund revenues than to shortages of highway revenues. Periodic or continuing state general fund shortages, resulting from recession conditions or from continuing federal retreat from funding state and local programs, may tempt legislators to formally or informally transfer highway funds.

Formal transfers can occur by reducing or eliminating the dedication of all or selected highway funds to highway purposes. Informal transfers take place through putting more of the fiscal responsibility to support other state functions, such as state police, driver education, and so on, into the state DOT/highway budget.

Threats to the maintenance budget can also arise from other external sources. Emerging requirements for bridge scour inspections, for example, were cited as potentially large new expenses. Environmental regulations or the need for cleanup of older maintenance facilities may place added burdens on the maintenance budget.

Tradeoffs are also continually being made among highway maintenance, highway rehabilitation or resurfacing, new highway construction, and support for other modes such as public transportation. Some states with inadequate overall funding have been facing the unfortunate tradeoff between matching federal construction funds and providing desirable levels of funding for maintenance. Under these extreme circumstances, maintenance funding often suffers because of the political impracticalities of letting available federal assistance be lost to the state.

Finally, many states have two basic policies: match federal revenues, and maintenance first. In periods of revenue shortfalls, it is probable that matching will receive a higher priority. Replacing maintenance work with federally assisted improvement projects is a possibility. However, the need to bring the entire roadway up to federal standards presents cost ramifications that can have serious budget consequences.

Checklist

What to Do:

- Review the potential threats, and

- Identify potential actions to overcome threats.

What to Include:

List and assess the following potential threats:

- Costs of meeting new or unforeseen environmental or safety regulations,
- Freezes of staff levels or budget levels,
- Large cost increases for materials or equipment,
- Organizational changes such as loss of effective maintenance budget champions,
- Political pressures to advance other programs, and
- Potential or actual highway fund diversions.

Who Should Do It:

- Maintenance management.

Guideline Eight: Deal creatively with change, as described in PennDOT's rule for change: "An effective budget process must have a built-in mechanism for growth which endorses bottom up suggestions based on what works for the organization, as it endeavors to creatively manage change." (3)

A strategy for effective maintenance budgets must also deal with complex, dynamic, and changing contexts and information.

A strategy provides guidance for how to act effectively throughout the budget development cycle. The strategy should encompass effective performance of maintenance. Effective performance must be an integral part of overall strategic planning, as well as of budget development and implementation.

Dealing with change in maintenance budgeting means dealing with both opportunities to improve maintenance effectiveness through new initiatives, and dealing with threats to the stability of budgets and the condition of the highways. Budget opportunities may arise as a result of new or more productive materials, equipment, or procedures that may allow an agency to propose new initiatives to improve maintenance practice and performance. The data compiled for this project show that many agencies are accomplishing more with less, or with constant workforce and dollar budgets. Virtually all agencies have adopted these goals. Productivity savings being realized are typically being reinvested into highway condition improvements.

Budget improvement opportunities may also arise from the concern of the public or industries and organizations with vested interest in well-maintained highways. In some states, the tourist industry and other industries believe that well-maintained and aesthetically pleasing highways are important for attracting tourists and business visitors, and for encouraging their return.

There may be many opportunities to bring maintenance budgets to proper levels or to more desirable levels if responses to changes are identified and strategies are developed to use the changed circumstances to enhance maintenance programs.

CHAPTER 3

GUIDELINES FOR INFORMATION AND MANAGEMENT SYSTEMS

Obviously there are wide ranges in the management and information system approaches and resources among the states. Those variations will continue and perhaps intensify as electronic information processing, databases, and management and information systems proliferate. Despite these differences, trends are emerging that have important potential impacts for maintenance-work-programs development, for the effectiveness of maintenance budgeting, and for field implementation of activities that meet objectives.

Information collected and analyzed from maintenance management, pavement management, and bridge management systems, as well as others, have been extremely important to effective maintenance budgeting. The following are among the types of data or information commonly and successfully used in developing and presenting maintenance budgets:

- Expenditure data such as breakdowns of expenditure by type (labor, equipment, materials, contracts), maintenance activity, specific highway, highway system, and geographical area;
- Pavement, bridge, or other facility condition information, including estimates from pavement and bridge management systems of how conditions will vary based on levels and timing of expenditures;
- Performance indicators relating to quantity or quality, such as miles maintained, miles of resurfacing, and miles of resealing that were accomplished to a specific standard;
- Maintenance backlog information, such as needs not being met under certain budget conditions;
- Presentations that illustrate the need for special programs or special efforts to correct problems (these can also include special studies of productivity, of program or investment needs, or of management options);
- Life-cycle cost estimates and economic impacts based either on infrastructure costs only or on infrastructure plus user costs;
- Comparisons and trends for factors such as vehicle miles of travel, lane miles maintained, levels of maintenance employment, levels of maintenance expenditures, and pavement age and condition; and
- Deferred maintenance costs and preventive maintenance savings.

Each of these categories of information can be highly useful, and each is discussed in the following section.

Guideline Nine: Expenditure Data—The agency should distill, analyze, and present expenditure information, preferably with geographical breakdowns, as part of both internal and external budget presentations.

Maintenance management systems (MMS) typically develop expenditure information for projecting and monitoring maintenance budgets and accomplishments. Expenditure data by type (activities and activity groups, labor, equipment, material, etc.), by system, and by geographical area, together with comparisons with past levels, have proven relatively easy to understand. Geographic breakdowns of expenditure data assist in helping interest groups, local officials, and state legislators to understand the stakes each has in maintenance budgets. The compilation of expenditure data also assists in promoting internal understanding of maintenance effectiveness by enabling the agency to relate expenditures by type to accomplishments and conditions.

The level of MMS expenditure information typically used for most MMS reporting is much too detailed for use in budget presentations to outside agencies. Breaking out categories of expenditure has been used in some states to help inform decision makers. In such cases, maintenance expenditure information might be aggregated into 10 or 12 categories (e.g., flexible pavement, rigid pavement, drainage, structures, guardrail, roadside, snow and ice control, and signage). Most typically, these categories of expenditures are also related to accomplishments, conditions, or level-of-service standards.

Checklist

What to Do:

- Compile expenditure information for a period of time—5 years should be sufficient, barring unusual conditions. Index the information so that it has a common base (the FHWA reports maintenance-cost trends annually in “Highway Statistics” using a 1977 base year). Concentrate analyses on activities and objects of expenditure that have significant budgetary impacts, but be prepared to reconcile to total current dollar expenditures. Summarize costs and trends by management unit, major categories of expenditure, and geographical area. Check to ensure that summary totals in the different formats are compatible or can be reconciled. Compare current requests with historical funding levels. Identify items that are likely to be controversial in the budget review and approval process. Concentrate analyses on significant real-dollar changes, but prepare total budget justifications.

- Prepare performance indicators where it is possible to do so—patching costs per cubic yard placed, mowing costs per acre, and sealing and overlay costs per lane mile. Make comparisons among internal management units and external contract forces.
- Prepare charts, graphs, and brief justification texts designed to communicate, not confuse. An effective rule of thumb is to confine each chart or graph to one story, one major thought. Design the materials in a modular format, with each module covering one budgetary issue or major budget component. Support the module with more detailed materials, but use the detail only if it is needed to respond to questions. Design the materials so that they may be used by a large number of presenters with minimum preparation time. Well-designed modules should be adaptable to many different presentation formats—transparencies for meeting use, handouts, 35-mm slides, presentation systems. Use color materials whenever possible.
- Provide the information to appropriate department managers and use it in efforts to improve operations. Set improvement goals and objectives, and prepare presentation materials describing them. Constant improvement attempts can be powerful measures in securing needed funding levels.
- Make all information meaningful for nontechnical, non-highway people. Do “dry run” presentations and solicit comments.
- Seek formal department approval on all presentation materials, and prepare the final materials in the formats the presenters prefer.

Who Should Do It:

- Maintenance management, and
- Budgeting staff.

Figure 7 is an example of how diverse information can be summarized and used to help tell the real maintenance story (4). The four graphs of the figure show:

1. Since 1970, vehicle miles traveled have been increasing steadily, up 122 percent, and lane miles requiring maintenance have increased by 16 percent. However, while maintenance expenditures were significantly increased between 1983 and 1987, after a 12-year decline, expenditures began to decline again in 1990. The number of full-time equivalent employees also declined over the 1970 through 1990 period by 18 percent.
2. Diesel tax rates have resulted in steadily increasing revenue losses thereby potentially diminishing the funding available for maintenance.
3. Improvements in fuel economy have eroded gas tax revenue collections.
4. Inflation has also eroded the purchasing power of revenues expended on maintenance.

Guideline Ten: Performance quality and quantity indicators should be used as primary management tools and as a means to present agency achievements and issues. Once a desirable level of performance is achieved, agencies should maintain an understanding of the agreed upon level of performance and of regular maintenance budget support.

The level of resources necessary to provide for the quantity and quality of work agreed upon is a budgeting issue that needs to be addressed. Quality indicators are useful to help achieve agreement on the desired level of performance.

Much of the information presented about agreed upon regular maintenance and rehabilitation budgets, and much of the focus of budget presentations, have been on performance quantity indicators and expenditure data. These generally relate to historical levels of effort or expenditure. If the budget level for maintenance is generally agreed to have been adequate, this type of information may form most of the basis for each year's maintenance budget. If there is general agreement that the work being done is the right work, the budgeting issue is more one of maintaining agreement on practices, and determining and controlling unit costs.

Once an agency has established positive working relationships and has achieved an agreed upon level of maintenance activities, effective agreement on core activities must still be maintained, although the primary focus in new budget cycles may be on new programs. Successful budget strategies have depended to a large degree on maintaining positive working relationships, and on establishing and continually updating the understanding of key actors about the maintenance program.

Successful agencies have maintained an ongoing, if always evolving, agreement with the administrations and legislators in their states on the levels of performance that are expected of the maintenance function. This means that there is a need for continued informal and formal interaction to determine what performance indicators are of concern to the legislators, local officials, the public, or interest groups. Some successful agencies have liaison staff—usually persons of significant line or staff responsibility within the agency—who will meet with the key legislative or administrative people on a day-by-day basis when legislatures are in session.

Performance indicators or quality indicators must be understandable to and relate as much as possible to the experience of lay persons. Although performance indicators must be based on a sound analytical and professional base, the communication of information about such indicators can't be understood unless the concepts being used are understood. Some successful agencies have used performance indicators such as percent of vehicle miles of travel subject to a rough ride (derived from surveys) to explain current performance or to address the consequences of alternative funding levels.

Additional guidance in developing and communicating effective performance measures can be found in the Governmental Accounting Standards Board research report, “Service Efforts and Accomplishment Reporting; Its Time Has Come, Road Maintenance.” (5)

Checklist

What to Do:

- Identify and evaluate techniques currently used as mea-

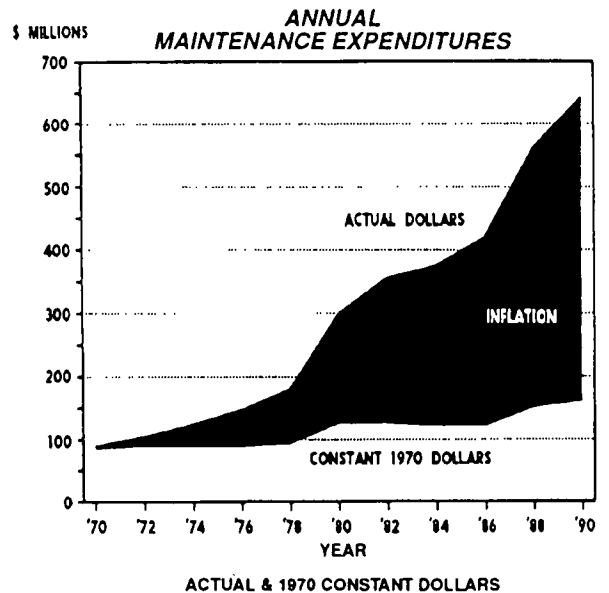
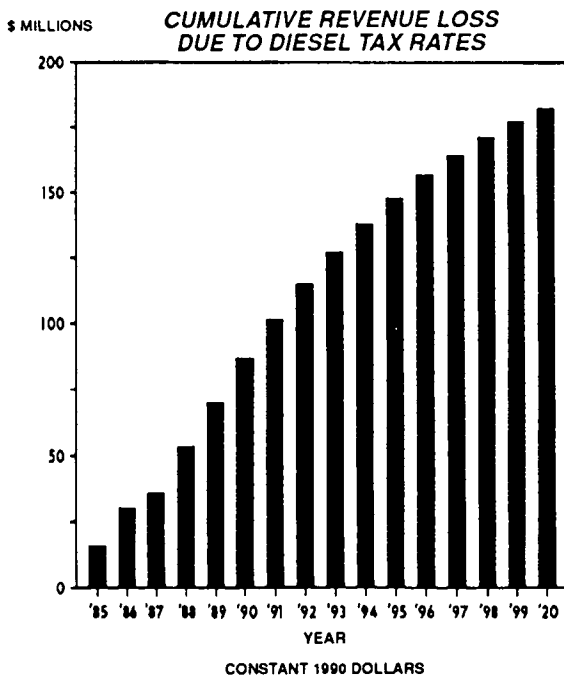
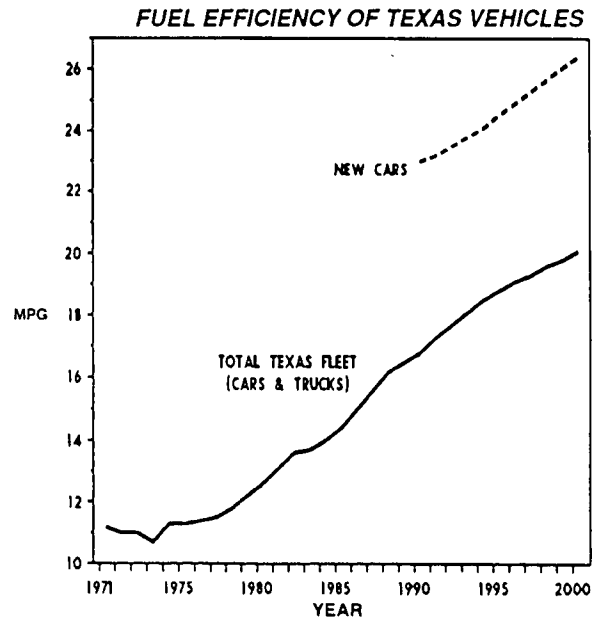
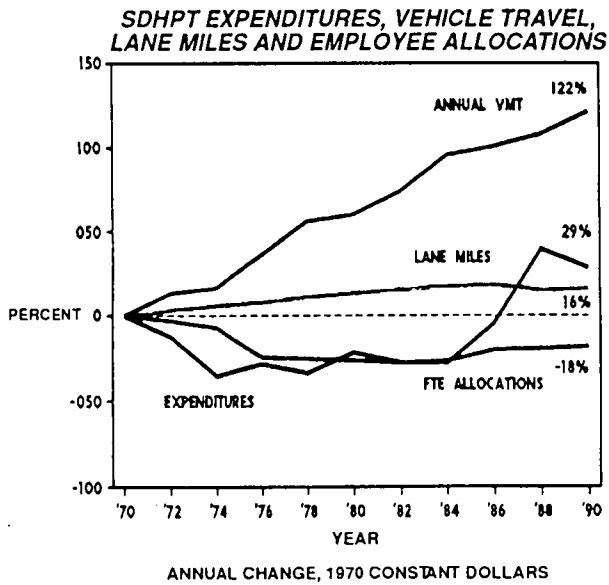


Figure 7. Example usage of statistics. (Source: Texas Department of Transportation)

asures of the agency's maintenance performance. Are they technically accurate and adequate? Will they be understood by the average person? Do they address the concerns of the legislature and the traveling public? Consider quantifiable condition trends by highway systems. Consider trends in the ages of pavements and bridges, and vehicle miles of travel. Consider real-dollar trends in maintenance expenditures.

- Establish and continuously refine measures of maintenance performance that are goals-and-objectives-oriented. Activity (function) based measures may be used to support these types of measures but should generally be avoided, because of the level of detail introduced.

Who Should Do It:

- Top management,
- Planning, and
- Maintenance.

Guideline Eleven: Condition Data and Projections—
Develop and use highway condition information throughout the internal budget process, and in communications with the public and decision makers.

More than 90 percent of the surveyed CAOs said they used road condition data to help advance maintenance-budgeting deci-

sion making. All but one state found the information to be effective or very effective in helping them achieve their objectives.

Condition data serve as a report card on whether the situation is improving or deteriorating. Where condition trends are deteriorating, these data may serve as indicators to all concerned that the budgets for rehabilitation and maintenance may need to be increased.

Projections of conditions under different funding levels can be developed under some pavement and bridge management systems. Projections have been helpful in illustrating the differences in conditions that are likely to be achieved under alternative funding levels. Such projections have been credited with playing a crucial role in achieving more adequate funding. These are discussed under the next guideline. A great deal of highway condition information has been available for some time. It started with 100-percent system sufficiency ratings for relatively short stretches of roads (control sections), progressed to present serviceability ratings on sample road sections that were selected using statistical techniques, is now maturing with the implementation of pavement management systems, and is being further supplemented, in some cases, by maintenance condition ratings. While much information is available, some problems remain:

- Finding ways to summarize and use the large amounts of data available, to update them and make them meaningful for maintenance purposes;
- Coordinating the use of condition information throughout the agency; and
- Preparing summary information in a way that is most useful to the public.

The relatively long time periods required in budget development cycles have compounded these problems, especially for routine maintenance. The hardware is available to process the information quickly. The top-level management job that remains is the coordination of agency efforts to ensure that information is not unnecessarily duplicated and that all potential users—especially maintenance managers—are aware of what is available, how it should be used, and what will become available as further developments and refinements continue.

In more specific terms, it appears that condition survey techniques and technologies, especially with advances being made in the equipment used, could be developed that would fulfill many agency road condition needs in a single survey. So doing will require high levels of coordination, further survey equipment developments, and the collection and aggregation of diverse types of information: pavement condition, sign reflectivity, encroachments, and the like.

Preparing maintenance budgets that address specific roadway conditions should be adopted as a long-term improvement goal. In the interim, transition steps can be designed and implemented as follows:

- Maintenance managers should be able to start to consider road conditions in budget decision making, in at least general ways, as is now being done in several states.
- Overall pavement and bridge condition summaries by management unit should provide useful guidelines in the allocation of maintenance budgets, especially when supplemented by dis-

cussions with district and resident maintenance engineers and managers.

- Maintenance managers should evaluate available pavement condition information and should begin to formulate techniques to correlate reported conditions and needed maintenance interventions, again with emphasis on high-cost periodic activities.
- Field inspections should be undertaken to confirm or modify correlations identified, and to identify roads and sections that deserve field inspections.

All users of field inventory and condition information—planning, traffic, maintenance, bridge, rights of way, materials, etc.—should combine forces to identify common and unique information needs, to explore techniques for common data collections, to identify skills needed in data collections, and to develop highly coordinated data collection practices. These efforts will probably be best guided by first identifying minimum information needs and then back-chaining to field data collections to ensure that all needed information is collected.

Condition information is also sometimes reported in relation to established standards using a numerical score for each condition and a standard defined as a particular score. Surveys of elements can be undertaken using either manual or automated data collection techniques. Maintenance element-condition surveys include visual inspections and a range of different technologies for measuring pavement conditions. Bridge conditions are normally determined through an engineering inspection of components.

Agencies with credible condition information have combined qualified personnel from both headquarters and district offices in making condition surveys. Lack of involvement by local maintenance engineers in the condition survey procedures may lead to a lack of acceptance of the results of the survey or of the results of subsequent analytical work, such as the development of improvement programs to remedy condition deficiencies.

Checklist

What to Do:

- Identify all current agency efforts to inventory highway facilities and to determine their condition. Identify how all of the information is used, and how the data are collected, stored, and processed.
- Confirm that all information currently collected is needed and used. Identify needed information that is not now being collected. Also identify all current agency plans for system and technique upgrades or changes.
- Evaluate the feasibility of merged or reduced levels of inventory and condition inspections and analyses. Identify costs of current systems and techniques. Design integrated data collection, storage, processing, and analysis techniques, if feasible. Consider all agency applications—maintenance management and budgeting, pavement management, bridge management, traffic and congestion management, planning, and federal condition-reporting requirements, and construction and rehabilitation. Check Guideline Eleven for compatibility or needed changes.

- Confirm proposed changes with all appropriate agency personnel. Develop an implementation plan and execute it.

Who Should Do It:

High levels of coordination and cooperation will be required. "Turf" and perhaps organizational considerations will be involved. All major elements of the organization should participate under the direction of top management. It will probably be desirable to set up one or more technical panels to report to a top-management committee.

Guideline Twelve: Backlog of Needs—When indicated to be a problem, an agency should identify or forecast a backlog of maintenance and rehabilitation needs.

Information about a backlog of unmet needs has been useful when there is a need to increase the level of maintenance expenditures in order to protect the road and bridge investment or to establish better conditions. The backlog of unmet needs in particular states has been identified and has been helpful in illustrating specific problems resulting from inadequate funding. Subsequent findings of a reduced backlog as a result of increased investment have documented the payoffs from increased funding. The backlog-of-need estimates are often generated by pavement or bridge management systems, usually with most of the focus on the output of the pavement management system.

Presentation of the backlog of needs should be accompanied by proposed alternative funding levels which would reduce the backlog over some number of years.

Checklist

What to Do:

- Prepare backlog estimates. Consider condition trends and the pavement design life. Prepare summary estimates by highway system of periodic maintenance and rehabilitation needs.
- Prepare cost and other resource need estimates.
- Prepare an implementation plan and schedule for the systematic reduction of the backlog.
- Coordinate the plan and schedule with planning, construction, and finance.
- Secure top-management approval.

Who Should Do It:

- Maintenance,
- Pavement management, and
- Bridge management.

Guideline Thirteen: New Programs—Use new programs to present budget initiatives.

When necessary, agencies should establish a new program to meet a need that has increased in priority. When a good case can

be made that deficiencies are substantial, whether in pavement or bridge condition, it may sometimes be an effective strategy to establish a new program to meet the special need. Such programs may help establish better conditions while adding to total funding and relieving the regular maintenance program of some of its burdens.

New program initiatives can help people to understand the need for higher budget levels. Since there are many ways to structure highway agency programs and budgets, some agencies have found that creating a special new program with its own budget may have more appeal. It is also possible that accomplishments under the special program may reduce the need for regular maintenance expenditures, thus, freeing additional needed resources. Special programs for bridges can upgrade bridge conditions and can reduce maintenance outlays for bridges. Rehabilitation and repair of bridges under some state special programs have reduced the need for regular state maintenance forces to devote their efforts and budgets to bridge repair.

Special resurfacing and rehabilitation programs, separate from the regular maintenance budget, can reduce the need for resurfacing and rehabilitation or alternative treatments that come out of regular maintenance funds. Resurfacing and rehabilitation programs are also generally managed by district engineers, who can either formally or informally reallocate regular maintenance resources to other routes. In this way, they can take advantage of the impacts of those programs on reducing the need for regular maintenance efforts on the improved facilities.

There is a potential downside to this approach. It may limit fund usage flexibility and lead to categorical fund usage restrictions.

Some agencies have successfully gained needed labor resources at no cost or at low cost through special programs that bring in volunteer or other labor sources. This has special benefits for agencies that have restrictions on expanding staff or are under requirements to reduce state work forces. There have been notable successes with "Adopt-a-Highway" programs and with the use of special labor forces (e.g., individuals with disabilities, inmates).

The Adopt-a-Highway program has spread to virtually every state. While it is difficult to quantify savings in all circumstances, at least one state was able to reduce its litter control budget by \$500,000 as a direct consequence of the program. The benefits are not only financial, however. Litter control may be more frequent, and the involved groups may be much more aware of their role as stakeholders in the agency's mission.

Rest-area cleaning work by the handicapped has been found to pay off in terms of reduced agency costs for the function being performed. The program serves the dual purpose of maintaining rest areas at a reasonable cost and also bringing additional personnel into the productive labor pool, with consequent impacts on self esteem, reduced public social service costs, and increased public revenues resulting from turning people into taxpayers.

Some states have used inmate or correction agency labor for roadside work. However, results with inmate labor are very mixed. At least one state believes that the transfers out of its highway funds to the corrections department to pay for inmate labor represent a higher cost to the DOT/highway agency than would be incurred by performing the tasks with highway agency personnel. Other states report very low cost services that can be

provided with or without regular department supervisors for activities such as litter control.

The creation of special or new programs has merit as a key element of an effective maintenance budget strategy. The identification of a new program with new benefits may be much easier to comprehend as a rationale for increasing the resources devoted to maintenance than to argue for more money for more of the same activities.

One successful agency, which has achieved an adequate regular maintenance budget level, has established very regular and consistent annual reports and budget documentation for submission to the governor's budget office and the legislature. New needs and new campaigns are addressed in terms of additions to the regular program needs. Regular program needs have been agreed on in prior years and, although scrutinized technically, are generally accepted as the levels necessary to maintain good conditions. New expenditures can be necessary because of system expansion, special problems (weather, earthquakes, etc.), or more rapid deterioration than was anticipated as facilities approach the end of their service lives.

Checklist

What to Do:

- Evaluate the need for and potential benefits of using new programs to present budget initiatives or to reduce maintenance backlogs;
- Evaluate the probability of the loss of fund usage flexibility; and
- Ensure the acceptability of the approach with agency and state budgetary personnel, and top management.

Who Should Do It:

- Maintenance,
- Pavement management, and
- Bridge management.

Guideline Fourteen: Benefits of maintenance—Use information about the benefits of maintenance expenditures when such information becomes available.

"Although millions of dollars are spent each year on pavement maintenance, adequate information defining the benefit of preventive maintenance treatments is not available." (6) Research is now under way to quantify these benefits, but it is likely to be some time before the objectives are realized through the long-term pavement performance studies of the Strategic Highway Research Program (SHRP).

When feasible in the future, agencies should relate maintenance and rehabilitation budgets to the life-cycle costs of highways and bridges, and to user costs and overall economic impacts. While the work is now under way, little has been done in the past to explain or justify maintenance and rehabilitation expenditures in terms of life-cycle costs, user costs, or impacts on the overall economy of the state. The World Bank has conducted extensive research on such relationships. However, most

of the work relates to roadways far below the standard designed by transportation agencies in developed countries. The state of the art in developing such relationships is likely to advance rapidly, opening the opportunity for more widespread use of information that explains the impacts of maintenance and rehabilitation expenditures on life-cycle costs, user costs, and the overall state economy.

The research currently under way is important and needed. Still more research and development is needed to provide field personnel better guidance in the types of work activities they should perform—under varying field conditions—to achieve the agreed upon levels of road conditions.

Checklist

What to Do:

- Ensure that people are aware of the research currently under way and expected developments. Assign specific responsibilities for monitoring and reporting maintenance-related developments.
- Start to incorporate economic considerations into the maintenance-budgeting process.
- Familiarize all levels of maintenance management with these concepts and developments as they occur.

Who Should Do It:

- Maintenance.

Guideline Fifteen: Adopt a policy of all-resource maintenance planning and budgeting, and develop evolutionary plans for its implementation.

In the past, maintenance budgeting frequently has not satisfactorily assigned resources based on roadway conditions or condition variations among management units. Systems tended, unless influenced by periodic field inspections, to allocate resources as though all roads with comparable levels of usage were in essentially the same condition. Of equal concern, it has been difficult to associate the results achieved in terms of improving or deteriorating roadway conditions with adequate or inadequate levels of funding.

The primary difficulty was the collection and quantification of road and bridge condition information needed to better budget periodic maintenance activities and rehabilitations on specific road sections and bridges. That is a gap now being filled, in some agencies, by pavement and bridge management systems, and SHRP developments. As discussed in Guideline Ten, initial data collection plans are important, as are the techniques used in their updating and processing. Users should demand high levels of integration as they transition from traditional systems to those adopting new concepts and techniques. They should also ensure that the systems continue to fulfill the individual needs of planning, maintenance, bridge, traffic, and so on. Costs of duplications are an issue. Ensuring that managers have the accurate information in timely ways may be a greater issue. New systems are now required. Their effective design, development, and implementation will require the active involvement of top

management, and high levels of coordination among most units of the agency.

We are clearly at the threshold of new technology that could impact every aspect of maintenance management and budgeting. An all-resource approach to maintenance planning and budgeting could, given even current levels of technology, imply a need for geographical information systems, common databases, common reference systems, and interactive computers and videodiscs. The ability of maintenance managers to ride the roads "from their desks," and to simultaneously review current condition information, condition trends, prior-year maintenance budgets, current budget requests, and capital improvement plans is feasible in the foreseeable future—but that is not the intent of this guideline.

There are natural tendencies to protect and prolong practices that serve the interests of the units involved. Current practices should be maintained, in most instances, until side-by-side tests of old and improved techniques demonstrate the advantages that can accrue to the organization.

Checklist

What to Do:

- Implement Guideline Ten.
- Constantly evaluate new techniques for collecting, processing, integrating, and disseminating field inventory and condition information. Evaluate the feasibility of having people responsible for changes or additions to the highway system—construction, traffic, etc.—enter the additions or changes as they are made, thereby reducing the need for field inventories. Ensure that all information collected is usable and used.
- Require high levels of coordination and cooperation among all management units using field inventory and condition information.
- Ensure that evaluations are conducted of currently available information before new field information collections are authorized.

Who Should Do It:

- Top management, and
- Maintenance.

Guideline Sixteen: Integrate reporting for maintenance management systems, financial reporting systems, and pavement and bridge management systems.

Despite attempts to minimize input reporting, most agencies continue to report resource usage separately for both maintenance and financial management purposes. Relatively extensive field reporting is still required as a result of the following:

- The limitations of information processing and communicating;
- The difficulties in changing the design of financial input reports;

- The need to acquire detailed information to establish standards;
- The focus of control efforts on quantities of work done and their costs; and
- The incompatibility of information needs, time tables, and processing requirements.

Most importantly, it should now be possible for one input-reporting system to compile efficiently all of the information needed for both maintenance and financial management purposes. That system may continue to be made up of a series of payroll, equipment, materials and contract reports, or more modern field data collection systems, but it should no longer be necessary to duplicate any of the information. Financial acceptance of maintenance activity definitions will be a key consideration. Since transportation agencies typically do limited, if any, external activity reporting, that should not be a major issue. Adoption of this guideline should help agencies focus maintenance emphasis on the field highway conditions rather than on the process used to manage maintenance expenditures.

Ideally, all field managers would be allocated the resources needed to complete their work programs, and would be held accountable for attaining and maintaining the road conditions the programs should produce. Some states have made significant progress in the implementation of this concept, but techniques vary by state and by organizational level within the states.

NCHRP Report 363, "Role of Highway Maintenance in Integrated Management Systems," presents detailed recommendations to integrate information requirements and systems for a wide variety of functions (7). *NCHRP Report 361*, "Field Demonstrations of Advanced Data Acquisition Technology for Maintenance Management," describes various types of field data collection equipment that can be used for single-source data entry to avoid data collection and transfer duplications (8).

Checklist

What to Do:

- Compile completed examples of all maintenance and financial reports prepared by field maintenance personnel.
- Prepare flow charts showing where each copy of each report goes, and identifying how it is used.
- Meet with agency and statewide financial personnel to determine their requirements for financial reporting, purchasing, and inventory control. Identify financial reports that must be in specific formats to minimize processing time and problems, and to fulfill statewide reporting requirements. Explore the feasibility of exchanging electronic files rather than paper reports. Explore the potential for exception reporting. Ensure that reporting approval requirements are realistic and that those signing have the level-of-operations knowledge necessary to ensure that their approval is appropriate.
- Explore new reporting techniques and processes—electronic data collectors, voice recognition systems, etc.
- Get appropriate approvals for proposed changes.

Who Should Do It:

- Maintenance.

Guideline Seventeen: Integrate and use results of emerging ISTEA Management Systems.

Management systems will evolve rapidly now that they have become a high priority under the ISTEA for all transportation agencies at all levels of government. We expect very major advances to be made in terms of relating expenditures to conditions and to user costs.

For ISTEA management systems, a few basic ingredients are necessary to have a working system that serves the following needs:

Inventory of facilities, equipment, and rolling stock. This inventory must include all items large enough to be replaced with capital funding, and it must have sufficient detail to allow distinctions in capital and maintenance costs from one facility to another. It is very important to divide the inventory into "elements," where each element is a distinct type of facility or equipment having its own cost structure, deterioration rate, and feasible actions.

Condition survey. It is necessary to have a general idea of the condition of each element in the system. In some cases, age can act as an expedient proxy for condition, but the system is much more valuable to management if a routine, scheduled inspection process is in place.

Deterioration models. With a condition survey in place, it becomes possible to build and maintain deterioration models. Combined with cost factors, such models allow the quantitative analysis of the relationship between capital and maintenance expenditures. This is the only realistic way of systematically quantifying the preservation benefits of capital and rehabilitation projects, and it also permits quantitative distinctions among alternative maintenance policies. "Markovian" models have become an established methodology for network-level deterioration because they require less data than any other method. They express deterioration rates as the fraction of an inventory of facility elements that change from one condition level to another over a standard time period (usually 1 to 5 years). The models should also be able to improve themselves over time without any special effort, as long as a routine condition-rating survey is in place. Deterioration models are essential for the satisfaction of the ISTEA requirements.

Action and cost models. Cost factors are necessary to quantify both immediate budgetary requirements and future savings resulting from preventive maintenance and capital investment. The systems will include feasibility rules for identifying appropriate actions for all facility elements and system components, a cost file containing standard unit costs for the actions, and a database for tracking costs as they are actually incurred, to permit future updating and refinement of the standard cost factors. For specific project needs, users must be able to override the standard costs if a more formal cost estimate is available.

Performance impacts. Performance standards will provide both a screening mechanism and a multicriteria set of benefit indicators for use in setting priorities.

Prioritization and programming. The basic building blocks listed previously provide a consistent set of costs and benefits for the entire range of potential capital projects and maintenance policies. This systemwide consistency is critical, because it

allows the use of straightforward methods for setting project priorities, and analyzing the budget impacts of alternative policies. The latter type of analysis is one of the greatest benefits of a system, because it provides management with extremely quick and responsive feedback on systemwide decision issues, including a "what-if" capability that directly addresses the kinds of questions most often asked of top management.

Of the requirements for management systems discussed here, the most important from the point of view of maintenance budgeting may be the further development of "treatment rules" and "performance measures" for those various management systems. Treatment rules specify what actions (such as maintenance, rehabilitation, or reconstruction) should be taken based on estimates of the relative effectiveness of these actions in lowering life-cycle costs.

Treatment rules for bridge and pavement management systems identify specific actions to be taken under specific circumstances (conditions, costs) for bridges and pavements. The bridge and pavement management systems generate suggested levels of expenditures for categories that include maintenance, rehabilitation, and reconstruction. However, not all maintenance-related expenditures will be developed from bridge and pavement systems. Some other programmed actions are developed from maintenance management systems covering other elements (guardrails, etc.).

The treatment rules for maintenance management systems can include consideration of nonengineering objectives, such as aesthetic objectives, in the process of developing resource levels and allocations. Not all of these will be related to cost-effectiveness in a financial sense. Many maintenance expenditures are not related to the condition of pavements or roadways in terms of their physical strength or longevity, but are related to other aspects of their travel experience that the public may value highly. For example, litter control, mowing, landscaping, painting of guardrails and bridges, and many other actions are related to the aesthetics of the highway users' experience as well as to other performance measures. We do not expect cost-effectiveness analysis to shed much light on the dollar benefits of many of these important attributes. Rather, budget information should relate what will be achieved in these areas at alternative expenditure levels, so that informed judgments may be made by managers and legislators of the expenditures necessary to achieve their goals in these areas.

Checklist

What to Do:

- Review emerging ISTEA management systems on a regular basis to identify new results and analyses that can be helpful in maintenance budgeting. Give special emphasis to emerging information on the impacts of maintenance or other expenditures on performance measures of interest to the public.

Who Should Do It:

- Maintenance management.

CHAPTER 4

GUIDELINES FOR COMMUNICATION

The media and communication methods used must be appropriate to both the context and the goals of the interactions with inside and outside interests. Media and communications refer to the whole range of interaction possibilities

- Oral, face to face;
- Charts, graphs, flip charts;
- Memos or summary reports;
- Slides or viewgraphs;
- Maps;
- Pictures;
- Movies or videos; and
- Interactive computer programs or graphics.

Media can be used during all kinds of interactions

- One-to-one meetings,
- Group meetings,
- Telephone conversations,
- Teleconferencing,
- Formal and informal hearings, and
- Written communications.

Communications and media should be tailored to the audience

- Governor,
- Legislature,
- State budget office,
- Highway groups,
- Other special and public interest groups,
- Press,
- General public,
- Chief administrative officer,
- Budget officer,
- District or residency heads, and
- State engineer.

Guideline Eighteen: Develop and maintain year-round highway maintenance communication strategies and programs with the legislature, key executive decision makers, special and public interest groups, and the general public. Use appropriate forums and media to promote public understanding.

Great care is needed in the design of external maintenance-budgeting communication programs, in the selection of the media to be used in those programs, and the techniques used in delivering the programs. Ad hoc or piecemeal approaches to

communication of maintenance budget issues and options are not as effective as a carefully orchestrated and concerted approach. Collectively, the states that hosted site visits for this study offer many examples of effective communication strategies. They include preparation of briefing books for internal and external decision makers; regular contacts and periodic meetings with state legislators; publishing plans and programs that highlight maintenance in addition to capital improvements (especially identification of maintenance projects in various jurisdictions, regions, and districts of a state); publishing periodic reports on the "state of the highways," which call attention to the condition of roads, bridges, and other maintainable assets as well as the level of service being achieved by different maintenance activities; setting up a statewide telephone hotline permitting citizens to make maintenance-related requests and inquiries; publishing official notices in local papers of impending maintenance projects; and seeking support from highway interest groups and other constituencies.

Finding opportunities outside the normal budget cycle to tell the maintenance story may best be done with the assistance of highway support groups who may not now be maintenance oriented. Contract maintenance programs in some of the states may help to build the maintenance constituency, but it is more likely that maintenance will need to be considered an add-on to the construction programs these groups often promote. Environmental groups may also be a natural and untapped constituency for maintenance.

The temptation is to say that Madison Avenue approaches should be avoided. In the main that may be true, but certainly "Don't Mess With Texas" and "Adopt a Highway" have been effective in reducing litter and reducing maintenance expenditures for the level of service achieved. Consideration should be given to more fully publicizing the unsung heroes who perform the many tasks, invisible to the public, that keep the roads and bridges in good condition. If properly managed, news coverage of incidents, emergencies, and storm management can provide interesting stories that create a good impression. Also a state agency might hold a ribbon-cutting ceremony when it undertakes a series of maintenance projects to help generate the same positive publicity that accompanies the ribbon-cutting for a capital improvement.

An important consideration in the design of communication programs will be a clear definition of the agency's objectives and responsibilities. One transportation official expressed it best: The transportation agency cannot be perceived as a lobbying group promoting a pro or con decision (raise gas taxes, for example). Rather, the agency must be perceived as a technical adviser. The job is to inform decision makers of the needs,

Budget Communications

"I want to emphasize the importance of taking a *positive, cooperative, open, and pro-active* approach in dealing with key decision makers, be they elected officials, commission members, or top staff. It is wise to remember that negative or critical approaches are likely to be counterproductive. Positive approaches which I have found very helpful include:

- furnishing factual information
- providing decision makers with alternatives
- getting to know decision makers personally
- providing testimony at hearings, and
- cooperating with supportive lobbying efforts.

"Taking an active positive and cooperative approach in communicating with the media is also of key importance. The views expressed by the media can influence public perceptions through the selection of stories to be reported and through the views expressed by interviewees and reporters. I am sure most of you present have had opportunities to contact the media. However, here again the key word is *positive*. I don't think enough of us are proactive. Too many times we are reactive only. The stories are there on our good deeds if we just take the time to search them out and brag a little about our accomplishments."

Source: Richard Braun

Figure 8. Budget communications. (Source: Richard Braun)

alternatives, potential consequences, and the relationships among what may appear to be competing programs (capital improvements and maintenance). The selection of the alternatives to be adopted should be left to the executive and legislative budget decision makers, with the high levels of competent technical guidance that the transportation agency can and should provide.

Figure 8 provides the advice of Richard Braun, former MnDOT Director and Director of the Center for Transportation Studies of the University of Minnesota, on communications and media (9).

Checklist

What to Do:

- Implement Guidelines Nine, Ten, and Eleven.
- Identify target individuals and groups for maintenance budget discussions and presentations.
- Select the techniques to be used—personal meetings, group meetings, mailings, etc.

- Select the information to be presented for each meeting or presentation.
- Evaluate the presentation techniques that can be used, and select the ones to be used.
- Prepare presentation materials.
- Select the presenters, do trial runs, critique, and improve.
- Identify organizations and groups that currently support highway legislation. Identify other groups that may have an interest in improved roads and bridges. Evaluate their current or potential impacts on highway legislation. Evaluate the potential reactions of budget decision makers if these groups actively support highway maintenance.
- Meet with current and potential support groups. Explain how these groups can help to make highways better, and why their help is needed.
- Provide willing groups with maintenance presentation materials and information. Assist them in developing communication implementation plans. Consider presentations at regular civic meetings and the like that are attended by budget decision makers.

Who Should Do It:

- Top management, and
- Maintenance.

Guideline Nineteen: Select media to be used to be consistent with the expectations of the target audience, and document and learn from experience.

Agencies should choose media and communication methods that are consistent with the context and are based on how well the people interacting know each other, how formal the setting is, how large the group is, what information is being conveyed, and the time available. The questionnaires to the states, the results of which are summarized in Volume 1, indicate that many states are giving close attention to the use and effectiveness of the media. As summarized, agencies reported that they used handouts, slides, and overheads to make presentations to the governor or the legislature.

Some successful agencies have devoted intense efforts to making sure they are communicating maintenance budget information and supporting information in as effective a manner as they can. Some managers practice their legislative or outside presentations, which may include slides or overheads, in front of an internal agency audience of reviewers. They distill and refine their presentations in front of the internal audience so the presentations made to the legislature and public groups will be clear, straightforward, and understandable.

Presenters edit information into the messages that are important to the audience and to the purpose of the presentation. A particular challenge is to take the information from management systems, intended for internal management purposes, and refine it so it hits the key points of relevance to budget decision makers.

The media to be used need to be effective, but within the expectations of the target group. As multimedia and computer-aided presentations become more commonplace, and as costs decline, they may become effective budget presentation tools. However, in one state it was related that a videotape budget

justification had backfired. Rather than convincing legislators of funding needs, the presentation caused legislators to focus on the videotape presentation itself, and its cost of development rather than on the budget message the tape was attempting to convey. The probability of this type of reaction can be expected to vary among the states, and with the resources and techniques used. The understanding of the target group's need for communication regarding the cost and effectiveness of potential alternatives, and the necessity to present pictures of highway conditions, graphics, and the like, will be significant acceptance factors.

Techniques used should be consistent with the audience targeted, the objectives sought, and the expectations of budget decision makers. The target audience for litter control is the general public. The target audience for maintenance budgets is generally the agency itself, the executive branch, and the legislature. Certainly a greater public awareness of highway maintenance benefits is desirable, and advancement may be possible through selective communication programs. Still, it is doubtful that much impact will be realized. Highway maintenance has been characterized as the invisible service from the general public perspective. It is best appreciated when it is not being done. An effective maintenance-budgeting-communication strategy will allocate most of its resources to a relatively small target audience of executive and legislative decision makers, and highway support groups.

Guideline Twenty: Choose from an array of simple or more elaborate communications media.

An Arizona DOT survey of other states found that the most effective communication tool used by top management of transportation agencies was face-to-face contact. These types of meetings were rated as the most effective communications technique by a majority of the states. This does not imply that only face-to-face contact is effective, nor does it imply that face-to-face contact by itself will achieve the desired results.

Agencies can use visual images as well as sound or written words to convey messages rapidly and understandably. Pictures, particularly pictures of road or bridge conditions, have been used very effectively in slide presentations and reports. Many agencies illustrate deficient conditions with pictures of deficient facilities within the jurisdictions represented by the legislators and other officials to whom the presentations are being made. The presentations are accompanied by budget proposals that would result in remedies for the identified deficiencies. Maps, especially those generated by a geographic information system, can significantly strengthen a presentation and speed its preparation.

Much of the information discussed previously lends itself well to graphic presentations or charts. Information such as budget figures can be shown as constant dollar graphs or bar charts to illustrate whether and by how much maintenance budgets have been changing. Such visual images can also convey condition information, quality and quantity information, benefit information and other impacts in which the individual or group has interest.

Videotapes, color slides with synchronized audio tapes, and the like can provide effective illustrations and information. Other candidate media include handouts, transparency and slide projec-

tions, and flip charts with interpretations being provided by regular agency personnel.

Transportation agencies have demonstrated abilities to conduct public hearings and to convey technical information effectively. Reorienting these skills to maintenance presentations and discussions should not be difficult if supported by key agency personnel.

Checklist

What to Do:

- Inventory agency presentation development capabilities—hardware, software, audiovisual, etc.
- Inventory agency presentation delivery capabilities—overhead projectors, computer projectors, audiovisual projectors, etc.
- Inventory potential meeting site capabilities and limitations—electrical outlets, ability to darken rooms, projection screens, seating capacity, food service, etc.
- Evaluate the needs of groups and individuals to whom presentations will be made.
- Evaluate the needs and capabilities of each presenter.
- Develop a presentation strategy for each presenter.
- Develop presentations tailored to each target audience and presenter.
- Do trial runs.

Who Should Do It:

- Maintenance,
- Budget, and
- Public/Legislative relations.

Guideline Twenty-One: Work within, but do not be totally confined by, the need to summarize and standardize budget materials.

The information to be used, and the techniques used to present it, are constrained by the need for greater distillation and brevity as the budget process moves to higher levels. A great deal of detail and backup about maintenance budgets may be utilized within a DOT/state highway agency, particularly at the beginning of the process of putting budget proposals together. The most detailed level of data may not be appropriate for communicating information outside the agency.

The ability of the state DOT/highway agency to present information to support or explain budget requests is often somewhat limited by prescribed and standardized formats, which are required by the governor's budget office or the legislature. In such cases, some information deemed desirable to present may not be in formal submissions, but might be supplied in answer to questions from the governor's budget office or the legislature. The DOT/highway agency will normally seek to make the administration and legislature aware of such information sources.

By the time the budget information reaches the governor's budget office or the legislature, it will normally be summarized and formatted in a similar manner to the information presented for many disparate programs. Much relevant information may

be lost, and much of the impact of the information will be reduced, compared to what was actually available. Constraints on required formats for the budget submissions themselves probably cannot be overcome.

Fortunately, supporting the state CAO and the state maintenance engineer is usually a wide variety of sources of information that can be useful in maintenance budgeting, if the information is well packaged and is presented in the right format and at the right stage of the budget process, outside the constraints of the actual budget submission. As the source of professional knowledge, it is the responsibility of the maintenance engineers and other managers of systems to develop the objective information on which budget decisions and maintenance resource allocations should be based.

Guideline Twenty-Two: Concentrate the development and presentation of budget materials on substantive issues of most pressing concern to key audiences.

Internal budget presentations should focus on the pros and cons of budget options, and external presentations should generally make the best possible case for the department's recommended maintenance budget. This guideline reflects the survey results, which reveal that the vast majority of maintenance managers present alternative budgets and analysis to internal decision makers, whereas agency heads nearly always present a single recommended budget to the legislature. These are norms and not rigid rules. Indeed, one CAO recommended portraying to the legislature what incremental increases in the gas tax of one, two, and three cents would buy in terms of an expanded maintenance program.

The analysis and presentation of alternatives and justification of a recommended maintenance program and budget should address the following substantive issues.

TRENDS IN CONDITION, LEVEL OF SERVICE, COSTS, AND ACCOMPLISHMENTS

- The past and current conditions of the roads, bridges and other physical maintainable assets.
- Past and current levels of service being achieved through different maintenance activities such as mowing, rest-area maintenance, and snow and ice control.
- Past and current service lives of various maintenance actions such as seal coats, bituminous resurfacing, and concrete overlays and corresponding savings or increases in life-cycle costs.
- Past and current accidents and liability costs directly associated with highway conditions and directly addressable through maintenance.
- Past and current levels of congestion delay associated with maintenance work zones and with road and bridge deficiencies correctable through maintenance operations, especially incident management, snow and ice control operations, and emergency maintenance management.
- Trends in maintenance accomplishments by type of activity.
- The success of the department in completing projects and programs funded by the legislature.

- Trends in the number of service requests of different types received, and the average response time needed to provide the requested service.
- Trends in resource utilization, especially objects of expenditure addressed in the budget, namely labor, equipment, materials, and contracts.
- The results of productivity enhancement efforts undertaken in the previous budget cycle.

UNCONSTRAINED AND CONSTRAINED NEEDS

An assessment of the financial, labor, equipment, material, and contract resources required by alternative maintenance programs, based on various funding options, is normally a minimum maintenance-budget-development step even though it is not externally presented. Alternative budget levels should be realistic except for one that should be unconstrained. The purpose of this one is to explore needs regardless of funding limitations. This portrayal of options would detail what alternative expenditures these levels would buy in terms of projects and activities, and their distribution throughout the state.

CONSEQUENCES, PROJECTIONS, AND TRADEOFFS OF ALTERNATIVES

Projections of key trend variables, based on the alternatives analyses, may include the following:

- Conditions;
- Levels of service;
- Length-of-service lives of actions;
- Accident and liability costs;
- Congestion delay costs;
- Service requests handled;
- Labor, equipment and material costs; and
- Productivity.

Tradeoffs as a result of increasing or decreasing expenditure levels may include the following:

- Capital improvements versus maintenance;
- One type of physical asset or maintenance activity versus another;
 - Backlog of maintenance projects and actions associated with the alternative funding levels;
 - Dollar savings and improvement in conditions and levels of service because of preventive maintenance, which can be analyzed through life-cycle cost analyses;
 - Dollar costs and deterioration in conditions and levels of service because of deferred maintenance; and
 - The equity of options in terms of distribution of funds by program area and distribution of projects across the state (best illustrated through graphics and maps).

Example Presentation Materials

Figures 9 through 20 provide example presentation materials of the types that may be helpful in presenting maintenance information to decision makers and the public.

Service Life in Months			Activity	Accomplishments Per Day
Minimum	Average	Maximum		
2.8	6.5	12.5	Shallow Patching Hot Mix	6.7 to 7.7
0.2	0.3	0.7	Shallow Patching Cold Mix	5.5 to 8.9
1.0	3.7	3.8	Shallow Patching Winter Mix	5.4 to 8.0
1.3	5.3	7.3	Shallow Patching Portapatcher	4.3 to 6.5
17.1	24.9	30.9	Premix Leveling (Wedging)	8.8 to 15.1
24.6	26.4	32.4	Seal Coat Chip Seal	5.0 to 7.8
17.7	22.5	26.2	Sealing Longitudinal Cracks and Joints	5.9 to 6.7
8.2	13.1	17.4	Sealing Cracks	1.2 to 1.8

Figure 9. Service life and daily accomplishments for roads in poor condition. (Source: K.J. Feighan, E.A. Sharaf, T.D. White, and K.C. Sinha, "Estimation of Service Life and Cost of Routine Maintenance Activities," *Highway Maintenance Planning, Transportation Research Record 1102*, 1986)

ILLUSTRATING COST INFORMATION

Many reviewers may not understand that even though maintenance activities are very inexpensive compared to capital expenditures on a unit-cost basis, maintenance activities typically must be repeated frequently if roads and bridges are to remain in good condition. Maintenance management systems and budget information can be used to illustrate the basic information on activities, costs, and the lifetimes over which various treatments will last. Figure 9 shows credible information on "what you achieve per day of activity" and "how long it lasts" in terms of different types of treatments for roads in poor condition, and thus helps to illustrate the necessity for periodically repeating the treatments described. The major point to get across is that conditions can be maintained or improved for a considerable period of time utilizing accepted maintenance treatments, but they require resources and have limited useful lives.

Figure 10 shows unit costs from the same source, which illustrates the type of information that can be displayed to show how much periodic treatments cost. Use of such information as Figures 9 and 10 present will help decision makers understand what activities are undertaken, how often they must be repeated, and what they cost.

For bridges, available bridge management systems are able to portray programmed agency costs versus accomplishments and resulting backlogs of bridge needs. Figure 11 is a scheduled needs and backlog report from the Pontis system. This figure illustrates how a programmed pattern of expenditures can reduce backlogs of needs over time. User costs are also calculated by some bridge management systems, and illustrations can be included of the user cost consequences of bridge deterioration or of posting of bridges at lower than usual weight limits.

A comprehensive bridge management system such as Pontis or the North Carolina system can produce projected budget information for bridge maintenance, bridge rehabilitation, and bridge reconstruction, along with forecasts of conditions and deficiencies. Figures 12, 13, and 14 illustrate the output of the North Carolina bridge management system with regard to three important forecast elements out of a numerous range of forecast ele-

ments: maintenance costs, rehabilitation costs, and conditions by year, for the short and long term.

Budgets and programs for maintenance and rehabilitation are developed through the examination of alternatives in terms of projected costs and accomplishments. For the North Carolina bridge management system, for the Pontis bridge management system, and for many pavement management systems, alternative budget levels, constraints, or treatment rules could be examined to reach a decision about a desirable course of action. The consequences of each alternative course of action can then be illustrated to agency management and other budget decision makers.

ILLUSTRATING CONDITION AND PERFORMANCE INFORMATION

Figure 15 illustrates the condition of facilities under different budget assumptions (i.e., in terms of conditions).

Transportation agencies desire to measure performance for a variety of reasons including information for budgets, information for assessing employee or contractor productivity, and information for managing resources. Maintenance performance of units is measured and reported upon by many state DOTs and other agencies. An illustrative example is shown in Figure 16 (from Virginia DOT). The Virginia DOT measures conditions for roadways in each area of the state as a means of assessing the performance of its field maintenance offices. Rolling averages of conditions are used to illustrate recent experience and accomplishments.

ILLUSTRATING "WHAT WILL GO WRONG" WITH INADEQUATE MAINTENANCE

It is important to illustrate the consequences of inadequate maintenance budgets in a highly understandable way. Two important factors to legislators and the public are what will happen to road conditions and what will happen to future budgets.

Activity	Production Unit	Total Cost Per Production Unit
Shallow Patching	Tons of Aggregate	\$114.17
Premix Leveling	Tons of Premix	41.46
Full Width Shoulder Seal	Foot Miles	177.50
Seal Coating	Lane Miles	1,352.60
Longitudinal Joint and Crack Sealing	Lineal Miles	108.50
Crack Sealing	Lane Miles	290.00
Spot Repair of Unpaved Shoulders	Tons of Aggregate	13.64
Blading Shoulders	Shoulder Miles	13.73
Clipping Shoulders	Shoulder Miles	205.50
Reconditioning Unpaved Shoulders	Shoulder Miles	885.60
Clean and Reshape Ditches	Linear Feet of Ditch	0.61
Motor Patrol Ditching	Ditch Miles	377.80

Figure 10. Production units and costs. (Source: K.J. Feighan, E.A. Sharaf, T.D. White, and K.C. Sinha, "Estimation of Service Life and Cost of Routine Maintenance Activities," Highway Maintenance Planning, Transportation Research Record 1102, 1986)

TOTAL UNCONSTRAINED NEEDS: Type of Action	Years					
	1994	1995	1996- 97	1998- 99	2000- 01	2002- 03
Long-term steady-state MR&R needs	89	89	179	179	179	179
Backlog MR&R needs	4320					
Improvement needs	27898					
Replacement needs	22811					
Pipeline needs	0					
Total needs	5519	89	179	179	179	179
WORK PROGRAMMED: Type of Action	Years					
	1994	1995	1996- 97	1998- 99	2000- 01	2002- 03
MR&R costs programmed	290	76	1694	1409	583	792
Improvement costs programmed	1768	1024	6026	6944	4191	6081
Replacement costs programmed	2941	3899	2278	1636	5223	3111
Pipeline costs programmed	0	0	0	0	0	0
Total programmed costs	4999	4999	9999	9991	9997	9984
Total needs	55119					
BACKLOG: Type of Action	Years					
	1994	1995	1996- 97	1998- 99	2000- 01	2002- 03
MR&R backlog	4120	4043	2775	1582	1129	417
Improvement backlog	26131	25107	19081	12135	7944	1863
Replacement backlog	19870	15970	13692	12056	6833	3722
Pipeline backlog	0	0	0	0	0	0
Total backlog	50120	45121	35548	25773	15906	6002
User cost of improvement and replacement backlog	526852	195971	66769	12118	5010	820

Figure 11. Bridge management system output.

Maintenance Cost
(Millions)

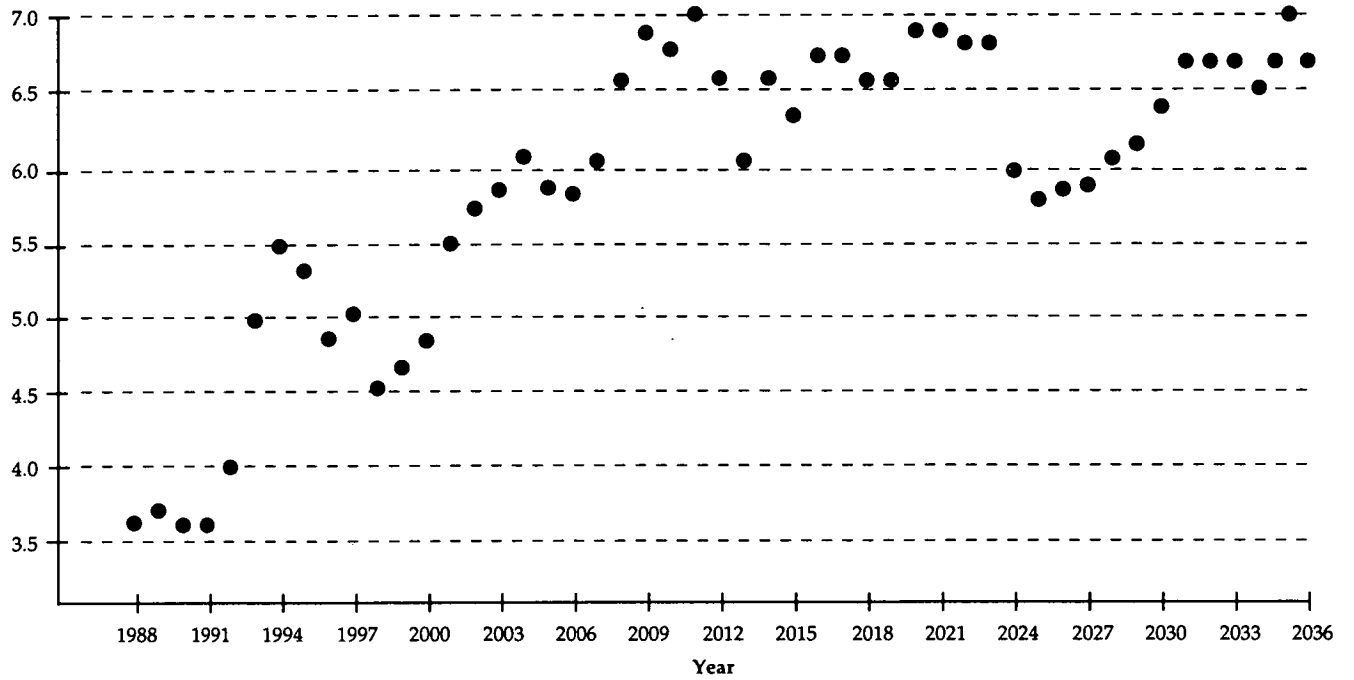


Figure 12. Predicted annual maintenance costs North Carolina bridge management system (illustrative case). (Source Chwen-jing Chen and David Johnston, "Bridge Management Under a Level-of-Service Concept Providing Optimum Improvement Action, Time, and Budget Prediction," North Carolina State University, 1987)

Rehabilitation Cost
(Millions)

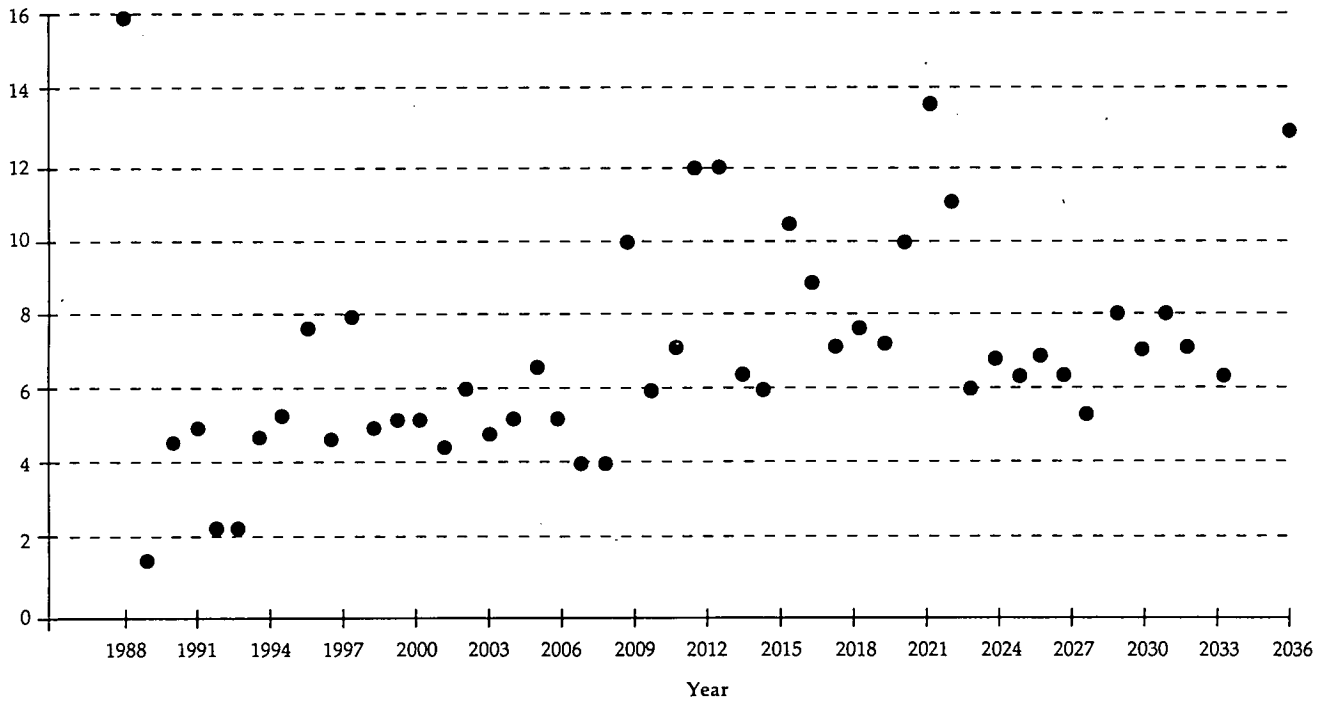


Figure 13. Predicted annual rehabilitation costs North Carolina bridge management system (illustrative case). (Source Chwen-jing Chen and David Johnston, "Bridge Management Under a Level-of-Service Concept Providing Optimum Improvement Action, Time, and Budget Prediction," North Carolina State University, 1987)

**Superstructure
Condition Rating**

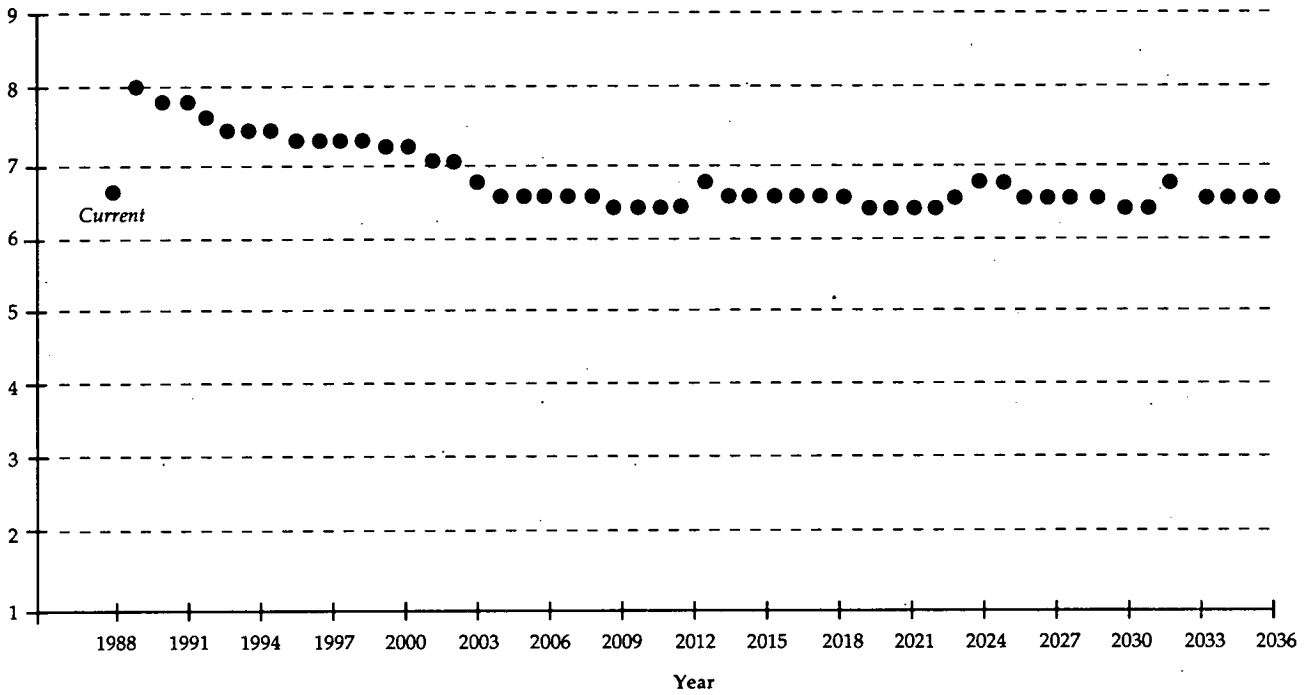


Figure 14. Predicted superstructure condition North Carolina bridge management system (illustrative case). (Source: Chwen-jing Chen and David Johnston, "Bridge Management Under a Level-of-Service Concept Providing Optimum Improvement Action, Time, and Budget Prediction," North Carolina State University, 1987)

**Average
PCR**

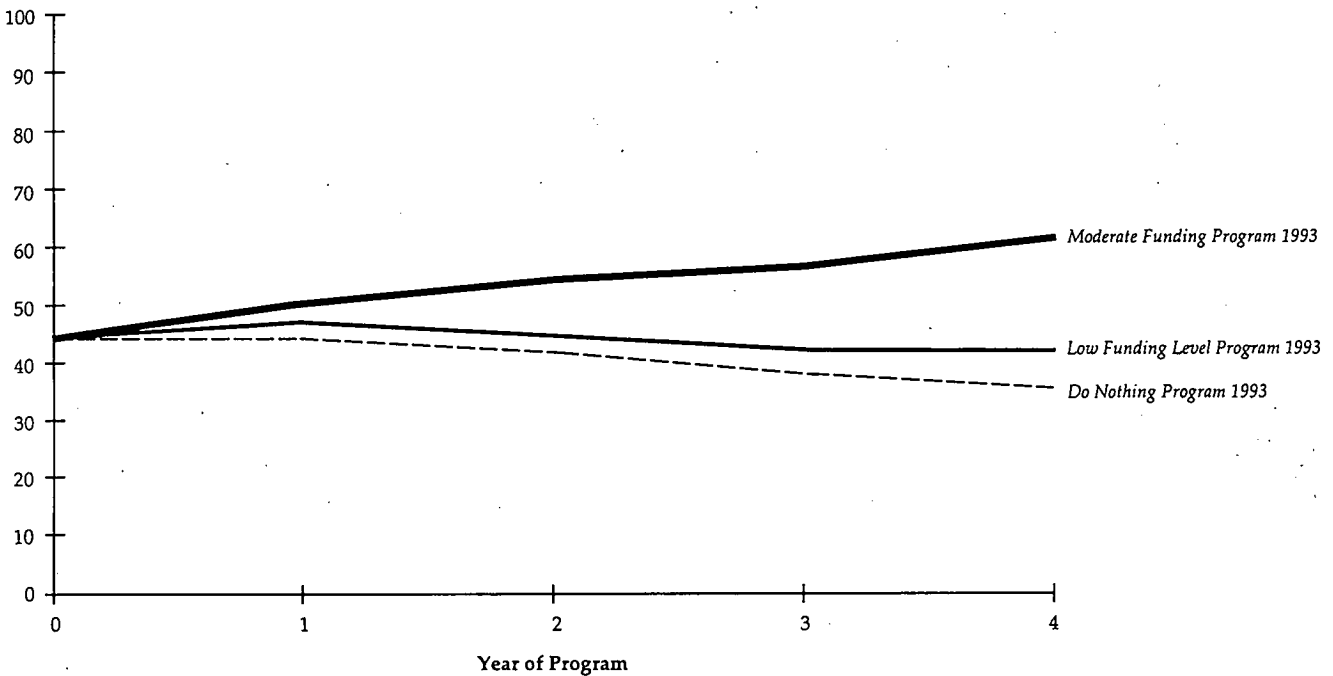


Figure 15. Forecast of PCR by program level. (Source: Cambridge Systematics, Inc. PMS System)

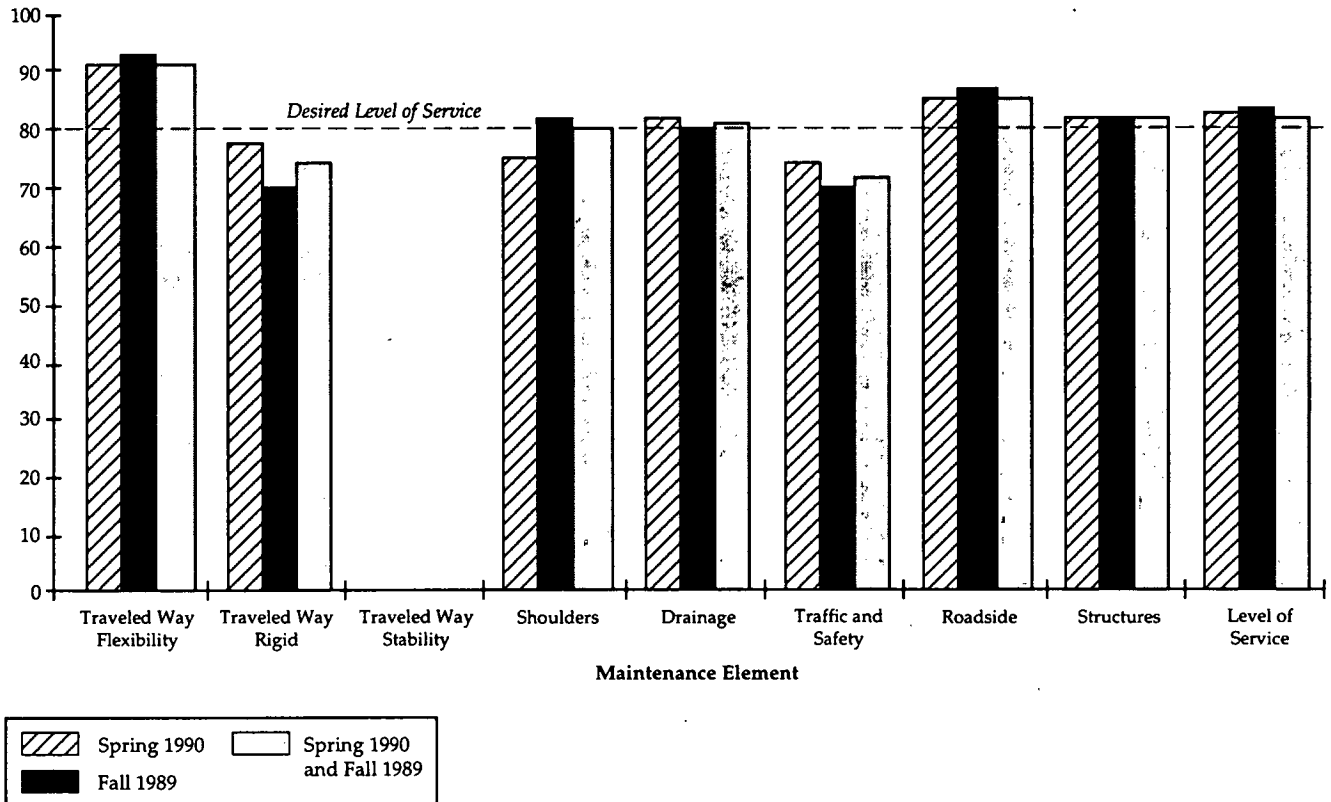


Figure 16. Level-of-service summary by maintenance element. (Source: Virginia Department of Transportation, "Maintenance Management Program," July 1989)

Figure 17 illustrates the impacts of lower than desirable expenditures over a period of time on roadway conditions and current needs. It illustrates that the impact of deferred roadway maintenance expenditures, at one period of time, is to increase needed expenditures in future years. The figure is presented in terms of actual allocations, needed allocations, and lane miles in poor and fair condition. As time goes by and budgeted levels remain below needs, the number of lane miles in poor and fair condition increases more and more rapidly. In addition, the annual allocations necessary to return to conditions as they existed prior to budget cutbacks also increase.

Needed future expenditures can be stabilized at higher budget levels, and long-term expenditures can be set to keep road conditions at a current average level. At yet higher annual budget levels, needed future expenditures can be reduced, and conditions can be improved over time. Given that the short-term cuts in the budget cannot save money in the long term, yet will yield significant short-term public criticism of road conditions, setting budget levels to maintain or improve conditions can avoid issues while not increasing long-term costs.

Figure 18 illustrates how alternative budget levels can improve conditions of pavements over time, and that there are budget levels at which there are good returns and higher budget levels at which there are decreasing returns from added expenditures.

Figure 19 shows one quantification of the relationship be-

tween pavement renovation or maintenance expenditures in the near term and reduced needs for reconstruction in the longer term.

Figure 20 illustrates the relationship of bridge preventive-maintenance expenditures over time to estimated other costs of eventual replacement if maintenance is not carried out. It is estimated that each dollar spent on preventive maintenance avoids three dollars in replacement costs for a bridge.

For every state, and for various road conditions, the types of results illustrated in Figure 20 will vary. It should be feasible over time for a state to develop illustrative information on the costs of maintaining or rehabilitating roads that have deteriorated to alternative levels of condition, so that the costs of bringing a road back to good condition (such as from various PSR levels) can be compared and contrasted.

Of course, the public could choose never to have roads in good condition, in which case there will be no need for maintenance or other expenditures. However, there have been few if any circumstances in which there has not been a public desire for serviceable roadways.

GUIDELINES FOR TRAINING AND SKILLS

Many maintenance units have developed effective technical training programs to improve skill and workmanship. Typically

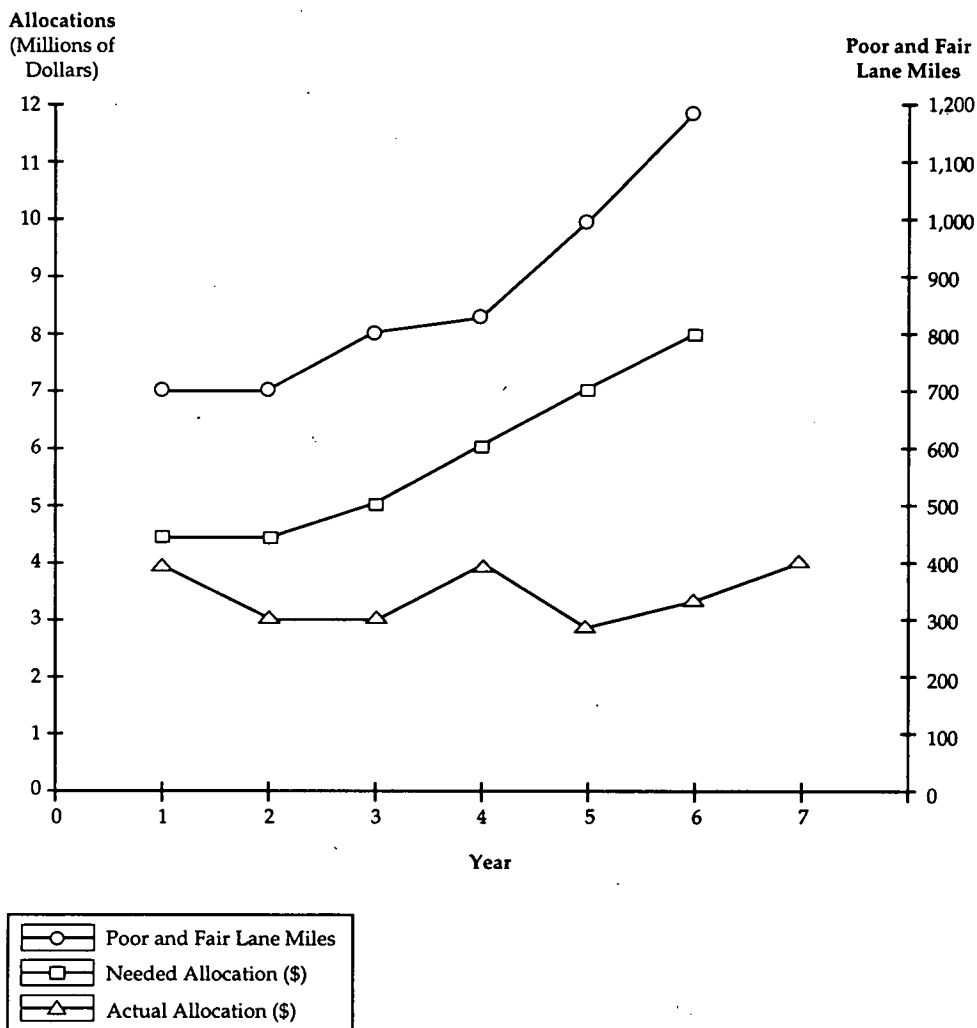


Figure 17. Actual vs. needed allocation and lane miles in poor and fair condition. (Source: Adapted from City of Cincinnati Department of Public Works, "The Public Works Story," 1987)

these courses cover types of maintenance interventions to be used (patching, sealing); work completion steps; types of materials to be used; crew and public safety considerations; and equipment requirements and usage. Some have equipment operation, maintenance, and repair programs as well.

Most states provide management training in one form or another. Programs are often combinations of internal management development efforts as well as nationally sponsored programs such as those conducted for AASHTO, the Highway Users Federation, and the FHWA. These courses are often attended by personnel with varying backgrounds and current work assignments (planning, construction, maintenance, materials, administration, etc.). Because of the varying backgrounds of the participants in the programs, the focus is usually on general management training covering topics such as communications, motivation, and leadership. While all is helpful for maintenance engineers and managers, little is currently focused on maintenance budgeting or maintenance management.

For sometime, transportation officials have recognized a need for the professional development of maintenance engineers and managers, a gap that is not filled by the typical civil engineering curriculum. *NCHRP Report 360*, "Professional Development of Maintenance Engineers and Managers," addresses educational and training needs of professional engineers and managers and should help to fill the void the research was directed toward (10). It is unlikely, however that resulting developments will include the specific programs, procedures, and strategies of individual highway and transportation agencies without the active involvement of those agencies.

Guideline Twenty-Three: Expand internal training programs to include the development and communication of effective maintenance-budgeting strategies. Include field maintenance managers as well as key central personnel.

A maintenance training program designed to improve the effectiveness of maintenance-budgeting-strategies development

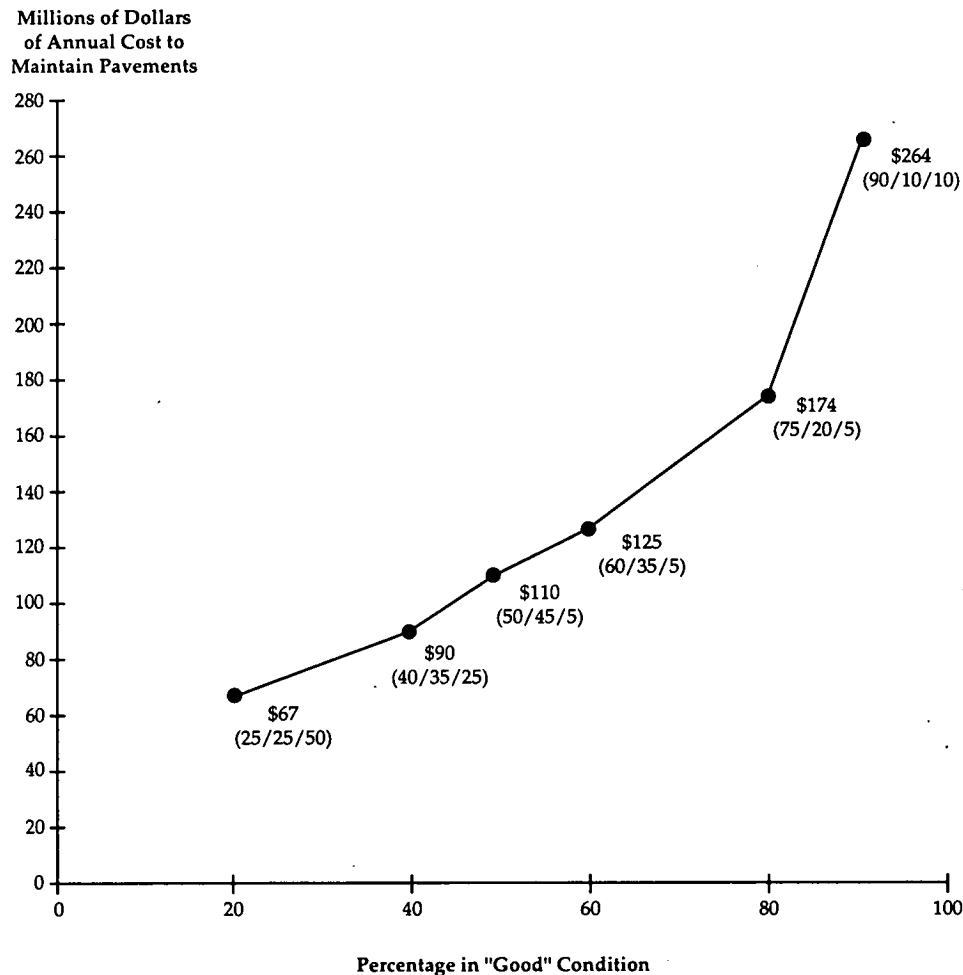


Figure 18. Performance of roadway surface (percent good/percent fair/percent poor).
(Source: Randy G. Granberger, "The Role of Pavement Management in Servicing a Significant Motor Fuel Tax Increase for the Colorado Department of Highways," 1986)

and implementation will address three basic needs. First there is a continuing need for all persons in the maintenance-budgeting chain to understand agency goals, how their actions will contribute to the attainment of the goals, and what their individual budgeting responsibilities are. While budgetary roles vary from agency to agency, many are focusing on pushing decision making downward, often to first-level supervisors. Reduced levels of supervision, employment ceilings, expectations of doing more for less, distributed data processing capabilities, supervisory development and motivation, and the need to gain internal as well as external credibility all argue for more decision-making opportunities at the lower levels of the maintenance organization. Training and constant updating will be required if the expected results are to be achieved.

The second major factor increasing maintenance-budgeting-training needs is rapidly changing technology—i.e., in the ways in which field information is collected, communicated, and processed. These training needs are intensified by changes in maintenance-budgeting technology itself. In the past, many states had substantially uniform quantity and performance standards

that drove maintenance-budgeting developments. Emerging techniques are incorporating a host of new criteria—individual and system road and bridge conditions, benefit and cost evaluations of alternative interventions (extensive patching, seals, overlays), user costs, resource availability—all of which will be new concepts for many key personnel in the budgeting chain. These new developments will be important tools in helping to improve maintenance strategies, if people understand what they are, what they do and how to use them.

The third major factor is the understanding and use of the information new systems make available. Standardized budgetary formats will necessarily continue. But the information available to maintenance managers in making the decisions that will be reflected in those documents is changing and will continue to change as new ISTEA and related management systems are implemented. It is probable that much of the information maintenance managers use will be designed so that they can look at their highway conditions from alternative perspectives, perspectives tailored to their own, often unique conditions—traffic volumes and weights, materials availability, equipment availability,

staffing, contracting opportunities and capabilities, weather, and so on. Work is already under way to build models that will optimize the distribution and use of resources for maintenance activities such as snow and ice control. Such systems will, in all probability, increase rather than decrease training needs as system user demands become more sophisticated.

Checklist

What to Do:

- Inventory and classify current maintenance training efforts.
- Evaluate current training efforts and training needs from two perspectives—advancement of the department’s capability to secure needed fund levels, and advancement

of capabilities to deliver effectively and consistently the programs the budgets promise.

- Identify training programs potentially available from current sources such as AASHTO and local educational institutions. Do not reject the possibility of local institutions developing courses specifically designed to fulfill the Department’s needs.
- Design, develop, implement, and continuously monitor the effectiveness of needed courses.

Provide opportunities for people with budget presentation responsibilities to practice their presentations with the benefit of peer reviews.

Who Should Do It:

- Human resources/Personnel/Training, and
- Maintenance.

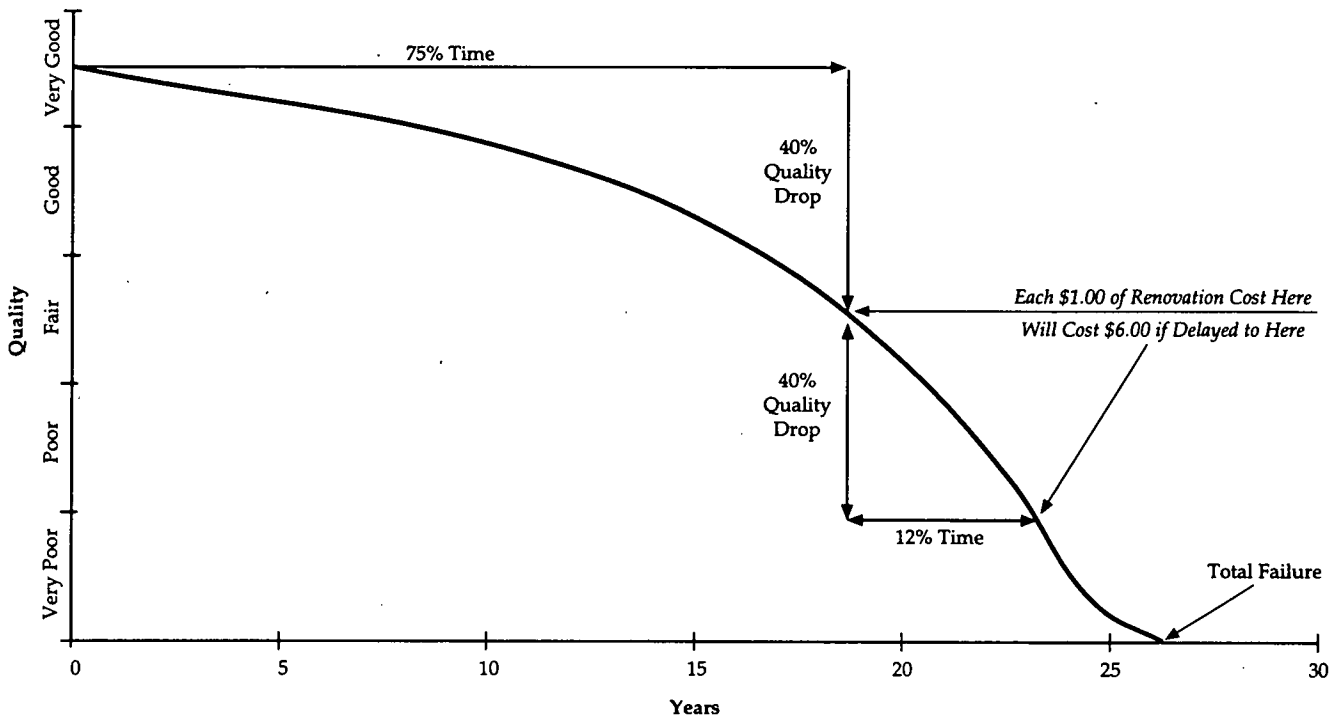


Figure 19. Road deterioration vs. time. (Source: L.M. Richter, "Pavement Management Saves \$3 Million," APWA Reporter, March 1988, p. 24)

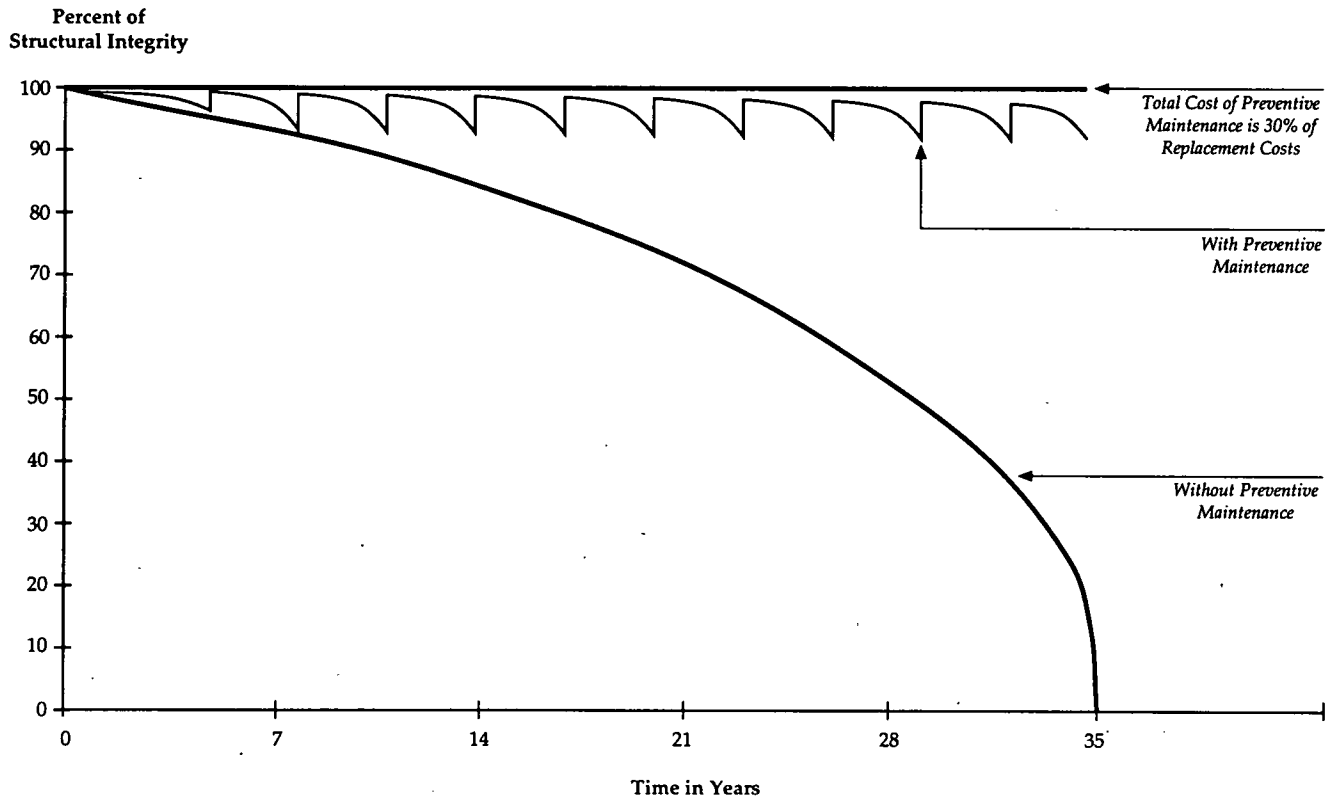


Figure 20. Bridge deterioration curve. (Source: City of Cincinnati Department of Public Works, "The Public Works Story," 1987)

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