SCAN TEAM REPORT

NCHRP Project 20 68A, Scan 14-01

Leading Management Practices In Determining Funding Levels For Maintenance And Preservation

Supported by the

National Cooperative Highway Research Program


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Acknowledgments

This study was conducted as part of the National Cooperative Highway Research Program (NCHRP) Project 20-68A, the U.S. Domestic Scan program. This program was requested by the American Association of State Highway and Transportation Officials (AASHTO) through funding provided by NCHRP. Additional support for selected scans is provided by the Federal Highway Administration (FHWA) and other agencies.

The purpose of each scan, and of Project 20-68A as a whole, is to accelerate the integration of innovative ideas into practice by information sharing and technology exchange among state transportation agencies. Experience has shown that personal contact with new ideas and their application is a particularly valuable means for sharing information about practices. A scan entails peer-to-peer discussions between practitioners who have implemented practices of interest and who are able to disseminate knowledge of these practices to other peer agencies. Each scan addresses a single technical topic that is selected by AASHTO and the NCHRP 20-68A Project Panel. Further information on the NCHRP 20-68A U.S. Domestic Scan program is available at http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=1570.

This report was prepared by the scan team for Scan 14-01, *Leading Management Practices in Determining Funding Levels for Maintenance and Preservation*. The members of the scan team are listed below. Scan planning and logistics are managed by Arora and Associates, P.C. Harry Capers served as the Principal Investigator. John A. "Jake" Almborg and Melissa Jiang provided valuable support to the team. NCHRP Project 20-68A is guided by a technical project panel and managed by Andrew C. Lemer, PhD, NCHRP Senior Program Officer.

The scan team members include the following individuals:

Mark McConnell PE, AASHTO Chair, Mississippi DOT

Dale Doughty, Maine DOT

Tim Lattner PE, Florida DOT

Laura Mester CPA, Michigan DOT

Cory Pope PE, Utah DOT (Retired)

Tony Sullivan, Arkansas State HTD

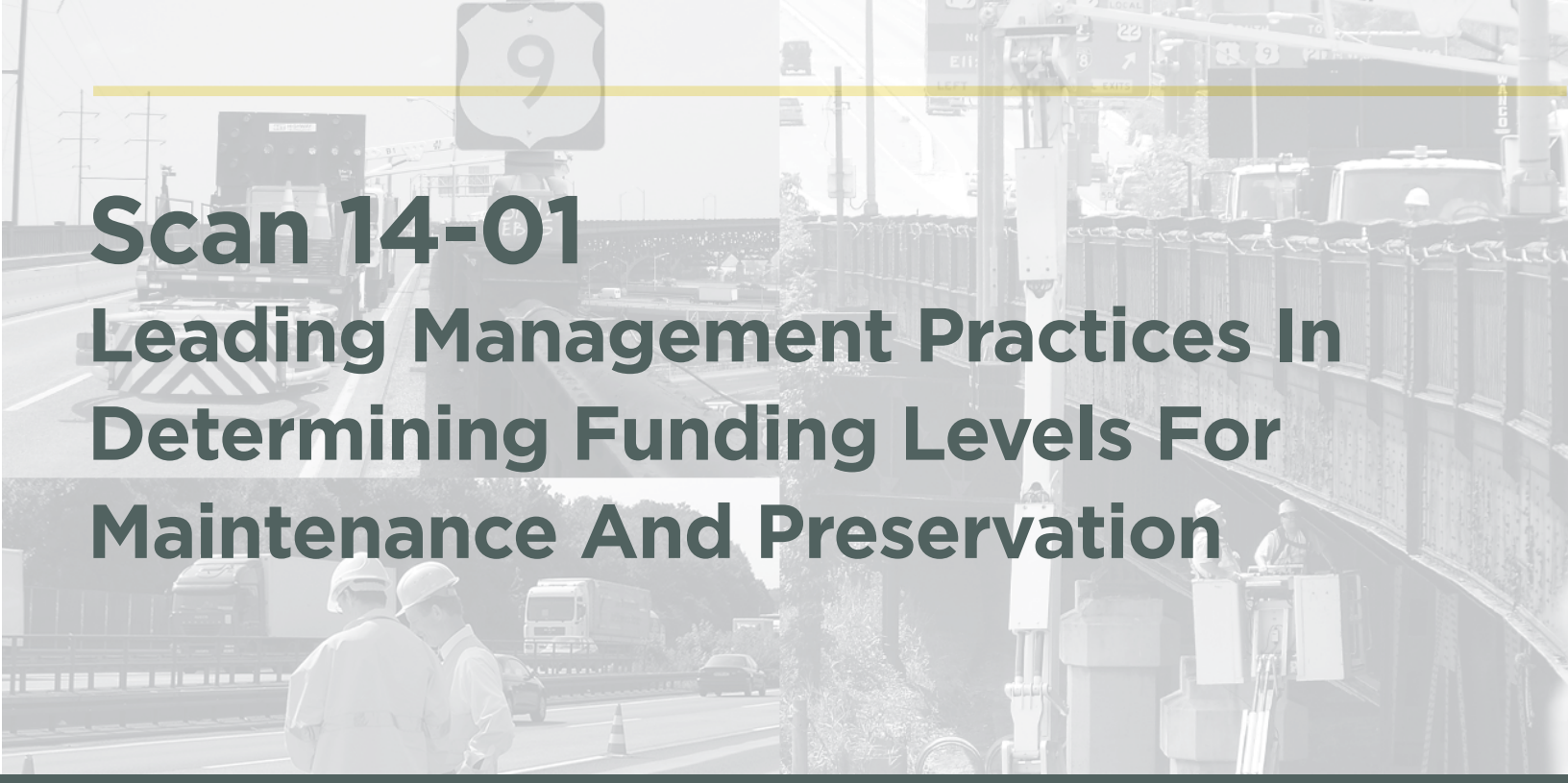
Thomas Van, FHWA

Lonnie Watkins, North Carolina DOT

Katie Zimmerman PE, Applied Pavement Technology, Inc., Subject Matter Expert

Disclaimer

The information in this document was taken directly from the submission of the authors. The opinions and conclusions expressed or implied are those of the scan team and are not necessarily those of the Transportation Research Board or its sponsoring agencies. This report has not been reviewed by and is not a report of the Transportation Research Board or the National Academies of Sciences, Engineering, and Medicine. Sciences, Engineering, and Medicine.



Scan 14-01
Leading Management Practices In Determining Funding Levels For Maintenance And Preservation

REQUESTED BY THE

American Association of State Highway and Transportation Officials

PREPARED BY

Mark McConnell PE,
Mississippi DOT, AASHTO Chair

Dale Doughty,
Maine DOT

Tim Lattner PE,
Florida DOT

Laura Mester CPA,
Michigan DOT

Cory Pope PE,
Utah DOT (Retired)

Tony Sullivan,
Arkansas State HTD

Thomas Van,
FHWA

Lonnie Watkins,
North Carolina DOT

Katie Zimmerman PE,
Applied Pavement Technology, Inc.,
Subject Matter Expert

SCAN MANAGEMENT

Arora and Associates, P.C.
Lawrenceville, NJ

May 2016

The information contained in this report was prepared as part of NCHRP Project 20 68A U.S. Domestic Scan, National Cooperative Highway Research Program.

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Abbreviations and Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AFSCME	American Federation of State, County & Municipal Employees
ALD	Accelerated Leadership Development (Missouri DOT)
APEX	Accelerated Professional Engineering Cross-Training (Missouri DOT)
Caltrans	California Department of Transportation
CE&I	Construction Engineering and Inspection
ConnDOT	Connecticut Department of Transportation
CT	Cross-Training, Cross-Train
DES	Division of Engineering Services (Caltrans)
DOT	Department of Transportation
EIT	Engineer in Training (Utah DOT)
HT	Highway Technician (Iowa DOT)
HTA	Highway Technician Associate (Iowa DOT)
HTS	Highway Technician Senior (Iowa DOT)
HR	Human Resources
LDP	Leadership Discovery Program (National Institutes of Health)
LMS	Learning Management System
MI	Management Intern Program (National Institutes of Health)
MLA	Maintenance Leadership Academy (Missouri DOT)
MoDOT	Missouri Department of Transportation
NCHRP	National Cooperative Highway Research Program
NHI	National Highway Institute
NIH	National Institutes of Health
OHR	Office of Human Resources (National Institutes of Health)
PE	Professional Engineer
PMF	Presidential Management Fellows Program (National Institutes of Health)
SME	Subject Matter Expert
TDOT	Tennessee Department of Transportation
TEP	Transportation Education Program (Utah DOT)
TLDS	Team Lead Development Series (National Institutes of Health)
TNG	The Next Generation Program (National Institutes of Health)
TRB	Transportation Research Board
TRID	Transportation Research International Documentation (database)
UDOT	Utah Department of Transportation
USDOT	U.S. Department of Transportation
VDOT	Virginia Department of Transportation
WISDOT	Wisconsin Department of Transportation
WSDOT	Washington State Department of Transportation

Executive Summary

Overview

Maintenance and operations activities are critical to the safety, smoothness, and sustainability of the nation's transportation system. Ongoing investments in planned maintenance activities reduce the overall cost of preserving the highway system and help keep the traveling public moving in a safe and reliable manner. As the nation's transportation system ages, gas tax revenues decline, and the long-term adequacy of highway funding remains uncertain, it is imperative that transportation agencies identify strategies that could lead to a more reliable and sustainable level of maintenance funding to address these growing needs.

Although the transportation industry recognizes the challenges associated with uncertain and inadequate levels of maintenance funding, practical and implementable solutions to address these challenges are not widely available. As a result, finding solutions to address these challenges remains a top priority. Securing adequate funding for maintenance is one of the most pressing issues for many state maintenance managers.

Within the transportation community, there is evidence of practices that have the potential to secure more consistent and adequate funding for maintenance and preservation activities. To explore this topic further, a domestic scan took place in the fall of 2015 to investigate successful practices that have led to reliable and adequate funding levels to support maintenance programs, as well as state Departments of Transportation (DOTs) that are using performance data to set performance targets, allocate funding to districts/regions, and establish maintenance priorities.

A desk scan was conducted to review information on the state-of-the-practice and identify promising practices. The results of this scan led to the observation that the practices of three state agencies indicated that either maintenance funding levels are adequately funded to address maintenance needs (Florida) or state maintenance funding allocations are largely based on needs-based budgeting to meet maintenance performance targets (Utah and Washington State); these states are referred to as Category 1 states. In addition, the desk scan identified a number of other state DOTs that are using maintenance performance data to allocate funding at the regional/district level and/or to improve fiscal accountability. These states, which included Arkansas, Arizona, Colorado, Mississippi, North Carolina, Tennessee, and Wisconsin) were classified as Category 2 states.

Based on the information from the desk scan, a regional model was used for scheduling two scan trips. The first, which took place from August 31 to September 3, 2015, began in Nashville, TN, where representatives from state transportation agencies in Arkansas, Maine, Mississippi, North Carolina, Tennessee, and Wisconsin presented information on the use of performance data in maintenance planning and budgeting activities. The week concluded in Florida, with presentations by representatives from the state DOT. In addition, representatives from Virginia DOT presented their maintenance practices by phone.

The second trip took place from October 5 to 8, 2015. The trip began in Utah, where the scan members heard presentations from the Utah DOT on its maintenance funding practices. Washington State DOT hosted the remainder of the trip. In addition to presentations by that agency's representatives on the use of performance-based budgeting to support maintenance activities, representatives from the Arizona and Colorado DOTs made presentations to the scan team on their maintenance planning and budgeting activities.

Summarized Findings

The key findings from the scan include those described below.

Finding 1: The culture within Category 1 agencies fully embraces performance-based management at all organizational levels.

A fundamental scan finding focused on the agency culture in the three Category 1 DOTs. Agency culture is a hard concept to describe. For the purposes of this discussion, culture is defined as the predominant attitudes, values, and practices that distinguish one state agency from another. An agency's culture is reflected in its internal and external communications, policies and priorities, business practices, and organizational decisions. An agency culture that strongly embraces performance-based management is a distinct feature of the Category 1 agencies that participated in the scan. These three agencies have the following characteristics:

- Everyone is on board, from upper management to maintenance technicians.
- Agency personnel can explain the organization's goals and priorities.
- Stakeholders, including maintenance personnel, have a place at the table to determine maintenance funding levels.
- The agency shows it is committed to performance-based management through word and action.
- Personnel are held accountable for achieving performance objectives.
- Resources that assist with achieving the goals are provided.
- Data, not historical allocations or practices, drives funding decisions.
- Continuous improvement is a mantra. Progress is reported regularly and feedback is solicited so that improvements can be made at all levels.

Finding 2: The Category 1 states and several Category 2 states have established a strong relationship with elected officials based on trust in agency decisions.

Establishing and maintaining a productive working relationship with state legislators was another key feature of Category 1 states and several Category 2 states. Relationships deemed productive are characterized by a give and take of information, mutual trust, and regular communication. Agencies that have productive working relationships with their state legislatures can respond quickly to requests for information or identification of needs. The legislators have confidence in the information their DOT provides them and in the DOT's ability to meet performance targets based

on the funding provided.

DOTs that have a good working relationship with their state legislatures recognize the ongoing effort that is required to establish and maintain that relationship. These DOTs work to educate new members of the legislature on how they establish and prioritize funding needs. They communicate regularly with the state legislature on their progress, making the information both meaningful and useable to the representatives. These DOTs also use the opportunity provided by these regular communications to explain anomalies or anticipate issues before they arise.

Finding 3: Performance measures and targets are needed to link investments with results.

Finding 4: Performance targets should be achievable with available funding and resources.

Maintenance performance measures are used to show the results of asset investments to executive leadership and to establish maintenance priorities for field personnel. Targets are often set based on funding available, statewide priorities, and customer expectations. Maintenance categories are typically prioritized, and those priorities are reflected in the targets that are set. Safety assets, for example, typically have the highest targets, while activities associated with aesthetics typically have lower targets associated with them.

Performance targets support budgeting discussions at both the statewide and district/regional levels. At the statewide level, performance targets drive the investment levels for funding maintenance. Once the maintenance budget is set, funding is allocated to the regions and districts based on the number of assets they maintain, the number of assets that must be addressed to reach their performance target, or some other factor.

One of the challenges that agencies discussed during the scan was getting maintenance personnel to understand that exceeding a performance target is not desirable. Although most maintenance personnel pride themselves on the quality of their work and would much rather receive an A on their maintenance quality assurance (MQA) scores, funding is usually not sufficient to fund maintenance activities beyond the targets on a statewide basis. This has been a cultural lesson that agencies have had to work on with their staff, shifting the attitude from getting the highest possible score to achieving the target.

Finding 5: The degree to which data is used to make investment decisions is strongly related to the degree of confidence that managers have in the information available to them.

Finding 6: Because of the importance of data and the demand on resources associated with these activities, several agencies have initiated efforts to streamline their data collection efforts.

Data is the foundation on which a performance-based management system rests. However, to be successful, data needs to be accurate and reliable, and all stakeholders need to have confidence in that data. As states make the transition from using historical expenditure information to performance-based data to predict and defend budget needs, they are making decisions about what and how much MQA data to collect, which methods of data collection to use, and how to ensure that the data collected is of the desired level of quality.

When there is a high level of confidence in MQA data, maintenance personnel can conduct analyses and communicate reliably with upper management, the legislature, and the public about performance. A significant level of confidence in MQA data allows agencies to use the information more broadly, and decision-makers can trust the information they receive and use it with confidence to make funding allocation decisions. Although most of the states that participated in the scan were collecting MQA data, there was significant variation in the levels of confidence in the data and, as a result, significant differences in how the data was being used.

The scan also found that several state transportation agencies are streamlining their data collection activities and integrating data usage to increase efficiency and reduce redundant and nonessential data collection tasks.

Finding 7: Performance-based organizations have established business processes, implemented software tools, and used available resources creatively to support their programs.

Adequate program support extends beyond just funding. Agencies that have adopted a performance-based program have business processes, software tools, and other resources available to support their efforts.

Recommendations

The following recommendations were developed from the key findings.

Establish Performance Measures and Targets That Drive the Development of a Unified Agency Culture

Consistently demonstrated across Category 1 state DOTs was a culture that supported performance-based management at all levels of the organization. Performance data was used to communicate funding needs to elected officials and to show that available funds were being used effectively. These organizations use performance data to drive funding allocations to the regions/districts rather than relying on historical allocations that do not reflect need. Performance measures are established to support these activities, institutionalize agency priorities, build agency and individual accountability, and create a culture that emphasizes transparency. Within this culture, agency personnel know what is expected of them and how their success is being measured. Information is regularly shared internally and externally to monitor progress and establish or maintain credibility with various stakeholders. While funding is typically not sufficient to address all of an agency's needs, the agency has a clear vision of what can realistically be accomplished and communicates that vision using achievable performance targets that reflect constrained funding.

By establishing effective performance measures and establishing the DOT culture around them, the agency is able to:

- **Support investment decisions**
  Funding allocations for maintenance are based on need rather than on historical funding levels. As a result, agency priorities are addressed, and there is a high degree of confidence that performance targets based on available funding will be achieved.
- **Set priorities using a consistent, explainable methodology**
  Priorities no longer seem haphazard or based on the whim of political forces.
- **Explain the impact of different funding levels on performance**
  By establishing clear links between funding and accomplishments, an agency is in a better position to communicate funding needs and convey the impact that funding increases or decreases can be expected to have on level of service.
- **Build trust with the legislature**
  The agency can clearly state its goals, what it needs to meet them, and how it will measure its progress toward meeting its goals. The legislature knows what it can expect based on the funding provided and can monitor progress and make sure funds are being used as intended.
- **Align everyone in the organization**
  All employees know what the agency is working to achieve and can explain how their roles and responsibilities support the goals. This unifies the employees, transcending the traditional silos that divided different teams, departments, regions, and districts.
- **Establish an effective data collection and analysis plan**
  Rather than collecting vast amounts of data with no clear purpose, data collection and analysis efforts are focused on accurately establishing and explaining the current condition of the agency's assets, where that condition needs to be to meet the performance goals, and the level of funding required to reach those goals.
- **Improve communication and hold itself accountable**
  By establishing performance goals, the agency can communicate to all stakeholders what work it intends to do with the funding provided and how those decisions were made. The agency can also report regularly on its success and explain instances where goals were not met.

After Establishing the Agency's Performance Measures and Targets, Allow Regions and Districts Flexibility in Planning Work Activities

A foundational pillar of performance management is accountability at both the agency and individual levels. After they had established performance measures and targets, several agencies demonstrated the benefits of establishing a culture in which regions/districts were provided flexibility in developing their work plans in accordance with agency-defined performance targets. Various methods were in place to ensure that agency priorities were addressed, including audits, central office review of the work plans, and the use of a central-office maintenance coordinator. By establishing a culture that provides a balance between responsibility and accountability, agencies are able to:

- **Manage expectations in terms of performance rather than pots of money**
  This results in a necessary transition in the way business is done, shifting from the traditional focus on managing money to include a focus of equal importance: managing work activities.
- **Set attainable goals**
  The regions and districts are in the best position to know where money needs to be assigned to meet the required performance goals. They also need the flexibility to address changes in the condition of the assets or environment that could affect targeted levels of service.
- **Transmit the performance-based management culture to the regional and district levels**
  Aligning regional and district-level goals with the agency's performance goals reinforces the agency's performance-based management culture, and it becomes the established mode of doing business at all levels within the agency.
- **Establish and maintain credibility with communities**
  Regions and districts can explain to the communities they serve what they intend to do and how they intend to do it. They are able to regularly share progress and explain challenges to success. This transparency builds confidence and trust between customers and the agency.
- **Invest in tools and technology that allow for greater efficiency**
  Regions and districts that demonstrate their ability to use resources effectively make the case for additional investments in tools and technology that can increase efficiency and improve results.

Develop Customer-Driven Targets to Convey Need and Achievable Targets for Accountability

Agencies use their targets to tell a story to the public and the legislature. The targets help explain what work was done, the impact of that work on the network's overall condition, and what can be done in the future at various funding levels to maintain or improve the system. Targets also help the agencies to plan by establishing current and expected levels of service.

The participants in the scan demonstrated that performance targets should reflect factors that resonate with the traveling public and elected officials. However, for accountability purposes, the performance targets should be set at a service level that is realistic and achievable with the funding level provided. Aspirational goals, which set desired conditions unencumbered by funding limitations, serve an important role in communicating funding gaps to stakeholders; however, they cannot be used to foster accountability. Establishing customer-driven and achievable targets allows an agency to:

- **Be held accountable and show how level of service is tied to the level of funding**
  The target should be achievable with the funding provided, and the agency should be able to communicate how the level of service will change with different levels of funding.
- **Hold managers accountable for the decisions that are made and the level of service that is attained**
  In an organization with a strong performance-based culture, agency managers should welcome the responsibilities associated with their position and expect to be held accountable for the decisions that are made. This balance between responsibility and accountability is critical to ensure that agency goals are achieved.

- **Track and communicate progress and validate priorities**
  Data can be used to ensure that spending is supporting agency priorities and to make necessary adjustments when unexpected events occur. To foster accountability and transparency, agencies should regularly communicate maintenance accomplishments to both internal and external stakeholder groups.

Develop National Guidance on Data Quality, Governance, and Utilization

A key scan finding focused on the level of confidence that agencies had in their performance data and its influence on how extensively the data was used to make investment decisions. Differences in data collection methodologies and procedures among the states significantly influence the level of confidence in the data and its usefulness for making investment decisions and holding employees accountable.

As demonstrated during the scan tour, the 12 participating state DOTs represented a range of MQA data collection approaches. For instance, some of the approaches use automated data collection processes featuring LiDAR, while other states use manual processes to collect the data. Most of the states inspect representative samples to reflect statewide conditions, but the number of samples inspected varies dramatically. Additionally, the scan states represented a number of different approaches to manage data quality and to keep the asset inventory current.

Based on the scan's findings, data issues appear to be a significant obstacle that could hinder agencies' ability to adopt the Category 1 states' practices without national guidance in the following areas:

- **Data collection procedures**, including the determination of the number of samples that are needed to use data for investment decisions and accountability purposes at different levels of the organization
- **Quality managemen**t, to identify processes and procedures that result in high-quality data collection efforts that can be used to support maintenance investment decisions
- **Innovative uses of technology**, highlighting some of the innovative ways that maintenance personnel have overcome data collection challenges using technology
- **Data governance**, to help ensure consistency in the data collected, to establish data collection protocols for each type of data, to define roles and responsibilities for data management, and to map links to all users of the data
- **Data usage**, including examples of how performance data can be used to support investment decisions at different levels of complexity

CHAPTER 1

Introduction

Overview

Maintenance and operations activities are critical to the safety, smoothness, and sustainability of the nation's transportation system. Ongoing investments in planned maintenance activities reduce the overall cost of preserving the highway system and help keep the traveling public moving in a safe and reliable manner. As the nation's transportation system ages, gas tax revenues decline, and the long-term adequacy of highway funding remains uncertain, it is imperative that transportation agencies identify strategies that could lead to a more reliable and sustainable level of maintenance funding to address these growing needs.

The inadequacy of current maintenance funding practices is not new and is not isolated to transportation agencies in the United States. In June 2005, the World Bank published a report on the importance of timely road maintenance activities. The report indicates that "repair costs rise to six times maintenance costs after three years of neglect and to 18 times after five years of neglect"[1]. To address the need for timely maintenance, a number of transportation agencies, including the Maryland State Highway Administration[2] (MSHA) and the California Department of Transportation (Caltrans), report having adopted a preservation philosophy that addresses the needs of existing assets before new assets are added to the system[3],[4].

To further support timely investments in the maintenance of the highway system, the Moving Ahead for Progress in the 21st Century Act[5] (MAP-21) promotes the use of performance-based investment decisions to help ensure a state of good repair using cost-effective strategies over the life of an asset. The Asset Management Notice of Proposed Rulemaking[6] (NPRM), which documents the requirements under MAP-21 and encourages the use of sound maintenance practices in several ways, such as including a life-cycle analysis and a 10-year financial plan in the development of a state's Transportation Asset Management Plan (TAMP). The life-cycle analysis demonstrates the cost-effectiveness of planned maintenance and preservation strategies in reducing the cost of managing a highway network. The financial plan outlines expected levels of investment in maintenance, preservation, and rehabilitation activities. Both of these components

1 Burningham S and N Stankevich, Why road maintenance is important and how to get it done, Transport Notes No. TRN-4, June 2005, The World Bank, Washington, DC, http://siteresources.worldbank.org/INTTRANSPORT/Resources/336291-1227561426235/5611053-1231943010251/TRN4_Road_Maintenance.pdf

2 Maryland State Highway Administration, http://www.roads.maryland.gov/Home.aspx

3 California Transportation Commission Allocates $541 Million, Emphasizing "Fix-It First" Preservation and Effective Management, May 22, 2014, California Department of Transportation, http://www.dot.ca.gov/hq/paffairs/news/pressrel/14pr045.htm

4 Making the Case for Transportation Investment and Revenue, NCHRP Project 2024(62), American Association of Highway and Transportation Officials, October 2009, http://downloads.transportation.org/Making_the_Case_Transportation_Investment_and_Revenue.pdf

5 MAP-21 – Moving Ahead for Progress in the 21st Century Act, https://www.fmcsa.dot.gov/mission/policy/map-21-moving-ahead-progress-21st-century-act

6 FHWA Publishes Performance Management Final Rules and NPRMs Required by MAP-21, Transportation Performance Management, Federal Highway Administration, U.S. Department of Transportation, http://www.fhwa.dot.gov/tpm/rule.cfm

have the potential to raise the profile of maintenance activities and their importance within a transportation agency.

Although the challenges associated with uncertain and inadequate levels of maintenance funding are recognized, practical and implementable solutions to address the challenges are not widely available. As a result, finding solutions to address these challenges remains a top priority. Securing adequate funding for maintenance is one of the most pressing issues for many state maintenance managers.

Within the transportation community, there is evidence of practices that have the potential to secure more consistent and adequate funding for maintenance and preservation activities. This report summarizes the findings from a domestic scan that took place in the fall of 2015 to investigate successful practices that have led to reliable and adequate funding levels to support maintenance programs, as well as state Departments of Transportation (DOTs) that are using performance data to set performance targets, allocate funding to districts/regions, and establish maintenance priorities. The findings and recommendations contained in this report will be used to promote practices that lead to more reliable and sustainable funding for highway maintenance and preservation in the United States.

Scan Team and Participants

Scan Team

The members of the scan team included representatives from both state and federal transportation agencies. The team was led by Mark McConnell, the Deputy Executive Director and Chief Engineer for the Mississippi DOT[7], who served as the Scan Team Chair. Other members of the scan team included:

- Dale Doughty, Director of the Bureau of Maintenance and Operations, Maine DOT[8] (MaineDOT)
- Tim Lattner, Director of the Office of Design, Florida DOT[9] (FDOT)
- Laura Mester, Chief Administrative Officer, Michigan DOT[10]
- Cory Pope, Program Development Director, Utah DOT[11] (retired)
- Tony Sullivan, Assistant Chief Engineer of Operations, Arkansas State Highway and Transportation Department[12] (AHTD)
- Thomas Van, Pavement Management Engineer, Office of Asset Management, Pavements, and Construction, Federal Highway Administration[13] (FHWA)
- Lonnie Watkins, State Management Systems Engineer, North Carolina DOT[14] (NCDOT)

7 Mississippi Department of Transportation, http://mdot.ms.gov/portal/
8 Maine Department of Transportation, http://maine.gov/mdot/
9 Florida Department of Transportation, http://www.dot.state.fl.us/
10 Michigan Department of Transportation, http://www.michigan.gov/mdot/
11 Utah Department of Transportation, http://www.udot.utah.gov/main/f?p=100:6:0::::V,T:,1
12 Arkansas State Highway and Transportation Department, http://www.arkansashighways.com/
13 Federal Highway Administration, U.S. Department of Transportation, http://www.fhwa.dot.gov/
14 North Carolina Department of Transportation, http://www.ncdot.gov/

Katie Zimmerman, Applied Pavement Technology, Inc.[15] (APTech), served as the Subject Matter Expert to the team. Contract administration, scan organization, and travel support were provided by Arora and Associates, Inc. Harry Capers, Melissa Jiang, and John A. "Jake" Almborg from Arora were instrumental to the scan's success. Greg Waidley, CTC & Associates LLC[16], assisted the team with the development of a plan for implementing the findings.

Scan Participants

A desk scan was conducted to review information on the state-of-the-practice and identify promising practices. The scan's results led to the observation that the practices of three state agencies indicated that either maintenance funding levels are adequately funded to address maintenance needs (Florida) or state maintenance funding allocations are largely based on needs-based budgeting to meet maintenance performance targets (Utah and Washington State); these states are referred to as Category 1 states. In addition, the desk scan identified a number of other state DOTs that are using maintenance performance data to allocate funding at the region/district level and/or to improve fiscal accountability. These states, which included Arkansas, Arizona, Colorado, Mississippi, North Carolina, Tennessee, and Wisconsin, were classified as Category 2 states.

Based on the information from the desk scan, a regional model was used for scheduling two scan trips. The first trip, which took place from August 31 to September 3, 2015, began in Nashville, TN, where representatives from state transportation agencies in Arkansas, Maine, Mississippi, North Carolina, Tennessee, and Wisconsin presented information on the use of performance data in maintenance planning and budgeting activities. The week concluded in Florida, with presentations by representatives from the state DOT. In addition, representatives from the Virginia DOT[17] (VDOT) were able to present their maintenance practices by phone.

The second trip took place between October 5 and 8, 2015. The trip began in Utah, where the scan members heard presentations from UDOT on its maintenance funding practices. Washington State DOT[18] (WSDOT) hosted the remainder of the trip. In addition to presentations by WSDOT representatives on the use of performance-based budgeting to support maintenance activities, representatives from the Arizona and Colorado DOTs (ADOT and CDOT, respectively) made presentations on their maintenance planning and budgeting activities to the scan team.

15 Applied Pavement Technology, Inc., http://www.appliedpavement.com/
16 CTC & Associates LLC, http://ctcandassociates.com/
17 Virginia Department of Transportation, http://www.virginiadot.org/
18 Washington State Department of Transportation, http://www.wsdot.wa.gov/

Table 1.1 provides a summary of the participating state DOTs and the names of the individual presenters.

Scan Dates	Host Agency	Scan Participants
August 31-September 3, 2015	Tennessee DOT	Tony Sullivan, Arkansas DOT Dale Doughty, Maine DOT Heath Patterson, Mississippi DOT Delbert Roddenberry and Matthew Whitley, North Carolina DOT Chris Harris, Jerry Hatcher, Jim Maxwell, Chuck Rychen, Matthew Chandler, and Bret Dennis, Tennessee DOT Scott Bush, Wisconsin DOT
	Florida DOT	Rudy Powell, Kristin McCrary, Tim Allen, Kirk Hutchison, Mike Soto, and Jim Boxold, Florida DOT Jennifer Ahlin and Robert Prezioso, Virginia DOT
October 5-8, 2015	Utah DOT	Kevin Griffin, Lloyd Neeley, Michelle Lindgren, Cody Oppermann, Jeff Williams, Brady Roberts, Tim Ularich, and Ryan Ellsworth, Utah DOT
	Washington State DOT	Justin Crowder, Troy Keener, Arizona DOT Kyle Lester, BJ McElroy, and Mike Goolsby, Colorado DOT Pasco Bakotich, Rico Baroga, Joe Schmit, Greg Selstead, Andrea Fortune, Pat Morin, and Mitzi Frick and Washington State DOT

Table 1.1 Scan participants

CHAPTER 2

Agency Culture Impacts

An organization's culture affects the spirit with which performance-based management techniques are adopted and the extent to which performance goals drive investment decisions at all levels of the organization. During the scan, it became evident that Category 1 agencies embraced performance-based management throughout their organizations. Individuals within these organizations had a good understanding of how investment decisions were made and were often involved in setting investment priorities. These individuals had a high degree of confidence in the data that was used to drive decisions, so it could also be used to hold individuals, offices, and their agency accountable for the decisions that were made. Because of the importance of the data, these agencies placed a high priority on establishing business processes to ensure both data quality and availability. There was also evidence of computerized tools to support the collection and analysis of the data needed for performance-based decisions.

This chapter introduces each of the three Category 1 states and briefly describes characteristics of their culture that illustrate their support for performance-based management.

Florida

In Florida, accountability is ingrained into the DOT, at both employee and management levels. To a large degree, the emphasis on performance-based management is driven by state statutes, which emphasize preserving the existing transportation infrastructure, enhancing Florida's economic competitiveness and improving travel choices to ensure mobility. Florida Statute 334.046[19] (2014) states that, at a minimum, the department's preservation goals shall ensure that:

- 80% of the pavement on the state's highway system meets department standards.
- 90% of the department-maintained bridges meet department standards.
- The department achieves 100% of the acceptable maintenance standard on the state's highway system (currently set at a Maintenance Rating Program[20] [MRP] of 80).

As a result, the DOT is funded at a level that ensures that these targets are met before any funding is allocated for large construction or capacity projects. These goals have remained consistent for many years and are well known throughout the department. The existence of the DOT goals in state statutes has limited the amount of "interference" from elected officials in how funds are being used since they know that the Florida Transportation Commission[21] is providing oversight and meeting with the DOT at least quarterly. The existence of legislated targets also shaped the MRP since it is primarily used to demonstrate accountability rather than justify the need for a different level of performance as is done in many other states.

19 State Requirements: Florida Transportation Plan – Florida Statutes 2014, Florida Transportation Plan, Strategic Intermodal System, http://floridatransportationplan.com/pdf/Florida%20Transportation%20Plan%20%20State%20Requirements.pdf

20 Maintenance Rating Program, Office of Maintenance, Florida Department of Transportation, http://www.dot.state.fl.us/statemaintenanceoffice/MaintRatingProgram.shtm

21 Florida Transportation Commission, http://www.ftc.state.fl.us/

While FDOT is held accountable for meeting the goals outlined in the state statutes, the agency's employees are held accountable for their decisions in a number of different ways. For example, district operations are evaluated using quality assurance reviews (QARs) to ensure compliance with statewide policies, procedures, and standards. The central office QAR team spends approximately eight weeks each year conducting site visits to review documents, interview district employees, and observe field operations. The findings are discussed with the district offices, and a report is written. The district must address issues of noncompliance within a reasonable period. Although the QAR team reviews each district annually, it typically focuses the review on different cost centers (e.g., operation centers) each year so that all operation centers within a district are evaluated over time. The QAR's results may also be used in the annual evaluation of district personnel.

FDOT recognizes the importance of the data used to make investment decisions and has developed business processes to ensure that the data is current. For instance, maintenance needs are based on a statewide inventory or the Roadway Characteristics Inventory[22] (RCI), and individuals in each maintenance yard are assigned responsibility to keep the inventory on a fiveyear cycle. After a construction job is accepted, the maintenance yard has 90 days to get the information into the RCI using screens similar to the one shown in Figure 2.1. The Planning Division adds new roads to the inventory. FDOT has also developed a process for certifying the team leader of each MRP inspection team.

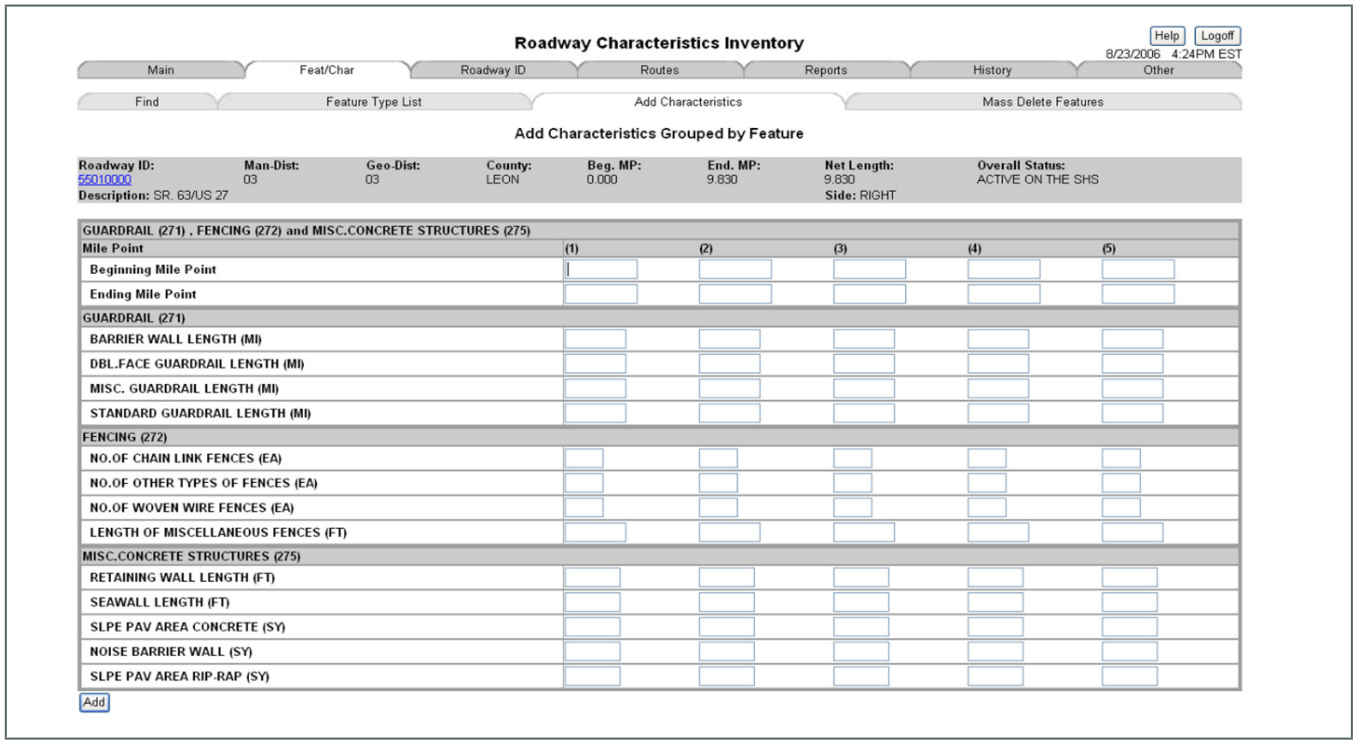

Figure 2.1 FDOT Roadway Characteristics Inventory input screen

22 RCI Handbooks, Transportation Statistics Office, Florida Department of Transportation, http://www.dot.state.fl.us/planning/statistics/rci/

Utah

The Maintenance Management Quality Assurance Plus[23] (MMQA+) program UDOT uses has become an important part of the agency's statewide culture. Originally modeled after WSDOT's program, MMQA+ was first developed to establish performance measures at the statewide level. However, one region fully embraced the program and used it to help set maintenance priorities and drive improvement. This region became a model for the state and its practices were implemented statewide. As a result, the MMQA+ program became a part of the organizational culture.

The implementation of the MMQA+ program was not an overnight success. UDOT had strong support from upper leadership; however, achieving buy-in among maintenance personnel in the maintenance sheds, where data quality was questioned, was a challenge. In 2003, UDOT conducted an audit that led to a shift from collecting data on representative samples to a 100% survey. The change had a significant influence on the organizational culture and the acceptance of the program data. The agency reports that it has taken approximately 13 years for its MMQA+ program to reach the point that UDOT can now answer the director when asked what it will cost to achieve desired performance targets. Region personnel know that they are held accountable for performance; excuses for missing targets are not accepted.

At UDOT, one of the important cultural changes that had to be conveyed was that of not "overshooting the target." It was important for the regions to understand that if they were spending money on activities with performance ratings higher than the target, they were likely neglecting another statewide priority. It took time for this philosophy to be accepted, however, the regions now take the process to heart and are no longer asking for additional funding for activities that exceed established targets.

Washington State

An organization's culture tends to shift with time, since each generation has different characteristics and tends to view the role of government differently. WSDOT established Executive Order 1096, which emphasizes a sustainable approach to addressing transportation priorities through using "tools and procedures based on accepted science, data, and proven practice." to ensure that the agency is delivering "the right solutions at the right time and at the right location (WSDOT Design Manual[24]). The focus of WSDOT's executive order is on safety, valuing people, practical solutions, and promoting economic development. In addition to recognizing the importance of data to achieve its objectives, the DOT also discussed the need to develop a culture that not only supports performance-based decisions, but also recognizes the generational differences in priorities that will lead to providing livable communities. Although the executive order did not specifically identify Maintenance, these personnel are embracing the philosophy and

23 Inspection Manual, Maintenance Management Quality Assurance Plus (MMQA+), July 2012, Utah Department of Transportation, https://www.udot.utah.gov/main/uconowner.gf?n=12425526747223783

24 Design Manual M 22-01.12, November 2015, Washington State Department of Transportation, http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/M22-01.12Revision.pdf

incorporating it into their culture. Because of the emphasis placed on culture, the department is increasingly focused on finding the right people for each job and using performance evaluations as a way to establish expectations and monitor performance.

Throughout WSDOT's presentations, there was an emphasis on the message that "they all own the condition of the asset." This attitude evolved from the realization that preserving asset conditions involves a blend of maintenance, preservation, and system improvements. This has led to a more collaborative approach to addressing system needs, which has enabled the department to overcome some of the traditional organizational silos. For example, Maintenance is working with Planning to identify steps to reduce the overall life-cycle costs associated with asset preservation. Maintenance has created an owner's manual/maintenance schedule approach for maintenance budgeting that is linked to the lowest life-cycle cost for maintaining assets such as cable barrier, signals, and guideposts.

Similar life-cycle strategies have been developed for pavements and bridges to help ensure that WSDOT gets as much life as possible out of these assets. For pavements, chip seals are used on roads with traffic volumes as high as 10,000 vehicles per day at about half the cost of traditional overlays. The bridge preservation program includes painting, waterproofing, and several other treatments designed to slow deterioration. As a result, WSDOT reports that it is making good progress toward "planning work activities rather than planning buckets of money."

WSDOT's culture also fosters collaboration; this is reflected in decisions on how maintenance funding will be spent. Organizationally, regional Maintenance personnel report to a region administrator rather than to the state maintenance engineer. However, the responsibility of how the maintenance budget is managed lies with the state management engineer. Without the direct, supervisory authority over the regional maintenance engineers, headquarters and regional maintenance managers must collaboratively develop program goals and objectives, track program delivery, and work together to manage adjustments throughout the 2-year budget period to effectively manage the program in an atmosphere of trust and teamwork.

A collaborative process is also used to compare the needs in the following three areas:

- Maintenance, including operations and preventive maintenance
- Preservation Program, including major repair and rehabilitation
- Improvement Program, which adds new assets to improve mobility and safety

As part of this process, WSDOT assesses each area's needs and determines their impact on other programs. For example, lengthening the preservation cycle has a direct impact on maintenance needs. This is communicated among policy makers and prioritization adjustments are made where possible and feasible. This type of collaborative process is increasingly carried out under the guidance and direction of a position that is viewed as an "asset manager" who is well-positioned with information, influence, and organizational authority to help effect the best decisions.

Communication is also an important part of the agency's culture. WSDOT makes a concerted effort to communicate performance information regularly and effectively with the legislature and

the public using methods designed to be effective for each audience. For nontechnical audiences, such as the legislature or the public, the information is presented in a way that communicates what they need to hear in a way that matters to them. For instance, The Gray Notebook[25], shown in Figure 2.2, is WSDOT's primary means of presenting information on transportation system performance to the public.

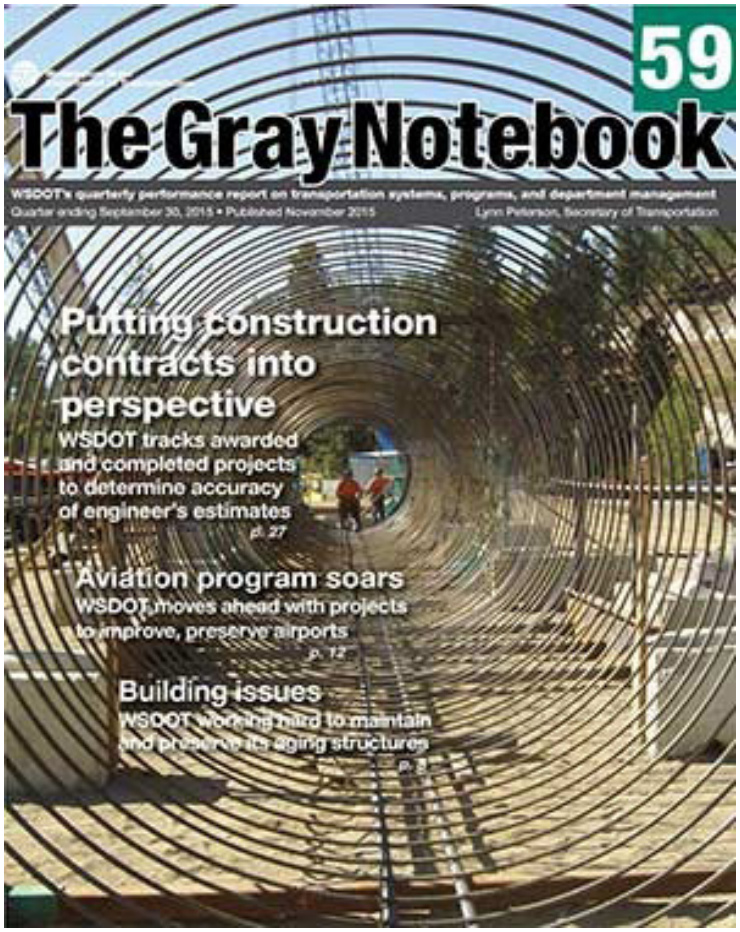

Figure 2.2 The Gray Notebook presents information on transportation system performance

25 Navigating The Gray Notebook, Washington State Department of Transportation, http://www.wsdot.wa.gov/Accountability/GrayNotebook/navigateGNB.htm

CHAPTER 3

Relationships with Elected Officials

In addition to having a strong culture that supports performance-based management, the Category 1 agencies and several other participating states displayed evidence of having developed strong, collaborative relationships with their elected officials and legislative staff. These relationships appeared to be grounded in a level of trust that the agencies manage effectively, as evidenced by promptly responding to requests openly with credible information. These strong relationships have led to positive results in several agencies when negotiating for maintenance funds.

This chapter presents some of the strategies that have been used to build these relationships and the resulting benefits. It also discusses some of the impacts that elected officials can have on maintenance funding and concludes with a summary of some of the challenges that the participating agencies face as they strive to strengthen their relationships with their elected officials.

Building and Sustaining Organizational Relationships with Elected Officials

Florida

Each of the Category 1 agencies has approached the development of relationships with elected officials in a different way. FDOT has established a Legislative Programs Office[26] (LPO) that keeps the public and elected officials informed of DOT-related issues and maintains a positive relationship with Florida residents. The LPO director reports directly to the Florida DOT Secretary and informs the Chief of Staff and the Legislative Affairs offices on DOT issues.. The LPO solicits and promotes legislative priorities for the department and works with the Executive Office of the Governor and the state legislature to move proposals through the legislative process. Any bills related to the DOT are tracked, and LPO staff writes, publish, and distribute positions on any bill that might affect the DOT.

26 Legislative Programs, Florida Department of Transportation, http://www.dot.state.fl.us/legislativePrograms/

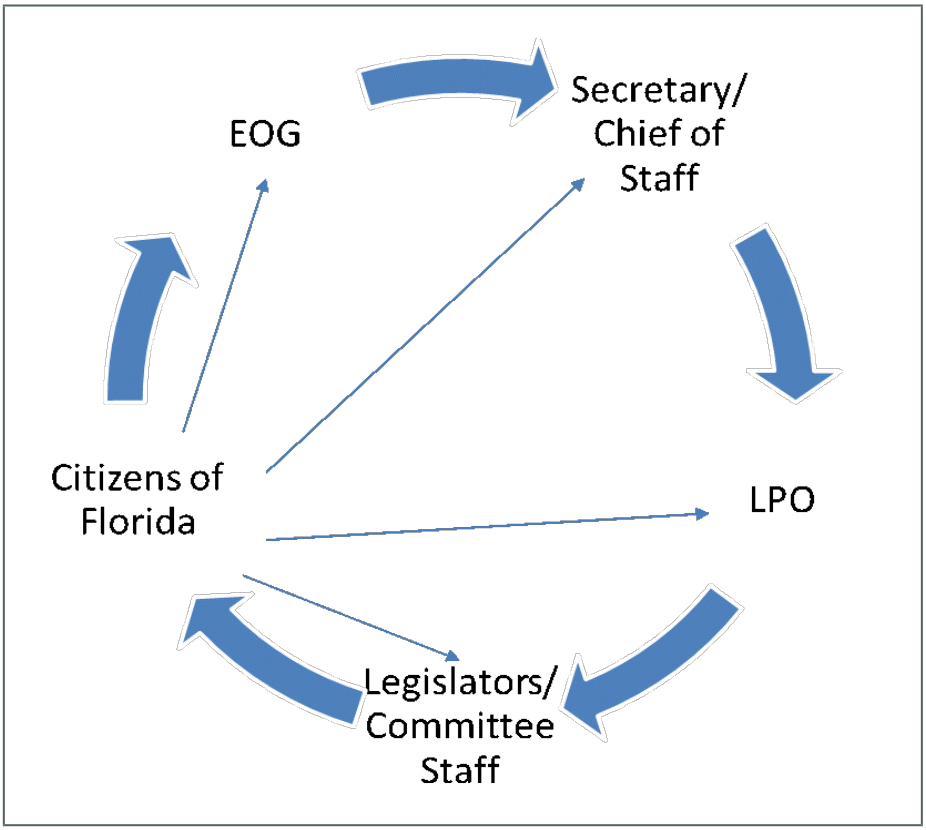

Figure 3.1 *LPO as a point of contact for citizens of Florida and a link between FDOT and the state legislature*

In addition, for the past three years each district has had a government liaison to serve as the "boots on the ground" for the district office. The liaison, who is a DOT employee, meets with mayors and other elected officials to proactively educate and inform them on DOT matters. Any relevant information is reported back to the DOT and tracked. The government liaison is not authorized to answer budget questions or questions about legislative policy language.

As discussed earlier, FDOT has recognized several benefits to the relationships they have been able to establish with their legislature. For instance, the governor is aligned with the DOT and believes that transportation is a way to support economic development and jobs. As a result, the state has been able to continue to pass legislation that supports preservation funding. FDOT reports that its success is largely due to its ability to use a predictable process to provide real information that addresses the questions that are posed in a timely manner.

Washington State

WSDOT's initial development of its maintenance accountability process (MAP) was triggered when, years ago, department personnel were unable to confidently answer the legislature's questions about the impact of budget adjustments. In response, the legislature mandated that a portion of the available budget be used to hire a contractor to develop a program that would address this deficiency. The DOT now uses information from its MAP each year to set the targeted level of service (LOS) and report the actual LOS and the estimated funding required to maintain the LOS to the legislature.

Over time, WSDOT has been able to establish a level of trust between itself and the legislature. According to WSDOT, the level of trust resulted from successful communications and the reliable exchange of information between both parties. The agency views the legislature as a top priority and makes a point of quickly responding to legislative requests with credible information. This has led to periodic budget increases using information provided by MAP.

As an example, WSDOT was recently asked to describe, on very short notice, what it could do with additional revenue. The agency was able to present a list of needs and a summary of the impact the additional funds would have on LOS quickly. As a result, it was awarded the additional funds. In another situation, an audit was conducted to evaluate WSDOT's practices. The audit praised the MAP program but emphasized the growing maintenance backlog caused by legislated investments in capital expansion that were not accompanied by corresponding funding for increased maintenance needs. The legislature and agency executives took note and provided funding to address some of the backlog. This included a $16 million program for a variety of assets and activities, including fully funding the backlog of preventive maintenance for median cable barrier.

Utah

UDOT has built up its credibility and trust with the legislature over the past 14 years, building on the goodwill that came from the early completion of improvements to I15 immediately prior to hosting the Olympics. Since that time, the DOT has made it a priority to operate transparently and push information out to stakeholders. This has enabled the DOT and the legislature to establish a collaborative working relationship that recognizes the importance of transportation to a growing state economy.

For example, UDOT recently worked with its Transportation Commission[27] to secure adequate funding levels to meet all of its interstate and Level 1[28] funding needs for pavements. Funding levels were inadequate to address the needs on the remainder of the system (i.e., Level 2 roads) beyond reactive maintenance. However, the dialogue and resulting predicted conditions caught the attention of the state legislators and brought heightened awareness to the need for additional funding. For the most part, Utah's elected officials tend to stay out of the DOT's project-selection process because the process is so data-driven.

Impact of Political Structure and Prior Experience on Maintenance Funding

Based on the discussions that took place during the scan, the makeup of the organizational entity that determines funding allocations and its prior experience and training often have a significant impact on how transportation is perceived and how successful DOTs are at securing desired levels of maintenance funding.

27 Transportation Commission, Utah Department of Transportation, http://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:12

28 Annual average daily traffic > 1000 and/or truck volumes > 200/day

For example, in North Carolina, both elected and appointed leaders have backgrounds in production and manufacturing, so they tend to focus more on outputs than outcomes. This philosophy carries over into budget discussions, which tend to focus more on the number of miles addressed rather than the LOS achieved.

A number of the participating agencies operate under the direction of a commission that must approve maintenance budgets. AHTD serves at the pleasure of the Arkansas State Highway Commission[29], which is constitutionally independent of the governor. Each of the five commissioners serves a 10-year term, and one person rotates off the commission every two years. As a result, the commission remains fairly consistent over time. In 2004, the commission established the Arkansas Primary Highway Network[30], which comprises interstates, U.S. highways, and other high-traffic highways, representing the highest priority for funding. The network comprises about 50% of the entire state-maintained network.

In Mississippi, three elected commissioners represent different regions in the state. Since the commissioners are elected, they are independent of the governor. Commissioners may serve as many four-year terms as they wish; therefore, historically there has not been much turnover in the commission.

In Maine, the DOT works with the Office of Budget and the governor's office to develop the transportation budget. Maine DOT works directly with the 13 members of the Joint Standing Committee on Transportation[31],[32] to justify the need for funding, which prevents them from having to justify spending to the entire legislature. Although the highway fund budget goes to the floor of both houses, most of the work is done at the committee level, which makes things easier to package and discuss in detail. The Maine DOT commissioner David Bernhardt previously worked in Operations at the DOT, which has proven beneficial in supporting maintenance budget requests.

Participants in the scan also indicated that it is easier to pursue a preservation-first approach when commissioners or other executive leadership understands the importance of maintenance. In Tennessee, the commissioner John Schroer made a statement that the Tennessee DOT (TDOT) is in a preservation mode. The commissioner has a real estate background and understands the value of maintaining property.

In Wisconsin, the secretary of transportation Mark Gottlieb is an engineer who has served as a Public Works director and as a legislator. The secretary understands the impact of various decisions on the agency's assets, supports data-driven decision-making, and is a strong proponent for maintenance.

29 Arkansas State Highway Commission, Arkansas State Highway and Transportation Department, http://www.arkansashighways.com/commission.aspx

30 AR: Arkansas Primary Highway Network, Nominee: Innovative Management – Small Project, America's Transportation Awards, https://americastransportationawards.org/past-projects/2011-2/ar-arkansas-primary-highway-network/

31 Joint Standing Committee on Transportation, Maine legislature, https://legislature.maine.gov/house/jt_com/tra.htm

32 The House and Senate are the sole committee of jurisdiction.

Facing and Overcoming Challenges

The participating states also noted several challenges in working with their state legislators to secure funding for maintenance activities. For instance, several of the participating agencies reported that maintenance funding levels are not always a matter of trust since many other factors limit the amount of money available.

Of the participating agencies, FDOT had the broadest and most diverse funding sources available for maintenance. Most of the other participating states fund maintenance using revenue sources that contribute to the Highway Trust Fund[33], such as the gas tax. Several participating states indicated that state highway trust funds are drawn upon for non-DOT uses, which limits available funds. At least one state indicated that general fund bonding is being used to support capital projects and heavy rehabilitation, which frees highway funds for maintenance. Most of the participating states indicated that they do little bonding, tolling, or GARVEE[34] financing to augment their highway fund revenue.

The Tennessee DOT reported that maintenance funding does not come from the general fund, which limits the amount of scrutiny by the legislature since they are not competing for other funding. TDOT receives only one appropriation (e.g., lump sum), which it divides to fund programs. VDOT reported that it, too, receives only one appropriation from the General Assembly. Based on the experiences of the Florida, Tennessee, and Virginia DOTs, there is apparently more flexibility in how states address agency priorities when the legislature allocates fewer appropriations.

Mississippi DOT indicated that it is difficult to get the legislature to view "performance-measure" metrics as anything other than accomplished work. The public considers mowing and aesthetics to be of the lowest priority when compared to other DOT functions in public surveys. However, mowing receives the most complaint-related responses from legislators and constituents.

To overcome these challenges, a number of states report that they provide information on maintenance needs to the legislature for both educational purposes and to show that they are using funds effectively. For example, the Virginia and Washington DOTs provide an annual report to the legislature to maintain credibility and demonstrate accountability. They also have web-based dashboards for transparency with the public and other stakeholders.

33 Highway Trust Fund, Federal Highway Administration, U.S. Department of Transportation, http://www.fhwa.dot.gov/highwaytrustfund/

34 Grant Anticipation Revenue Vehicles, Federal Debt Financing Tools, Tools & Program, Federal Highway Administration, U.S. Department of Transportation, http://www.fhwa.dot.gov/ipd/finance/tools_programs/federal_debt_financing/garvees/

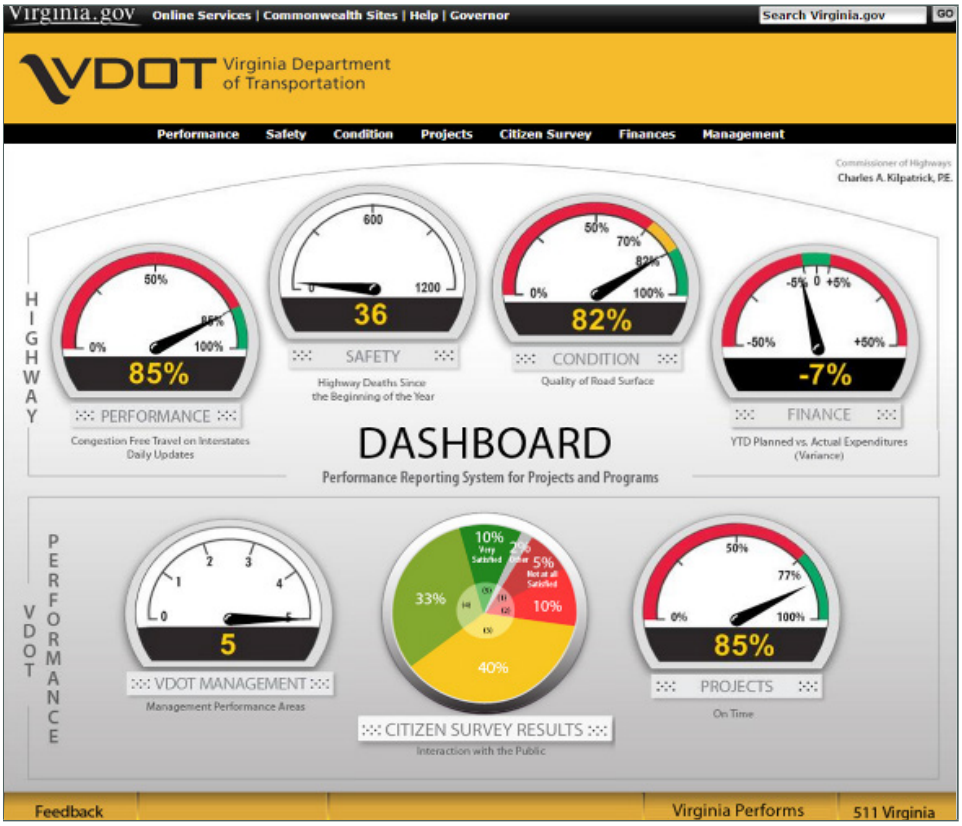

Figure 3.2 Example of the VDOT dashboard[35]

NCDOT provides a report to the legislature every two years to communicate current conditions and maintenance needs. The DOT also has a dashboard[36] that compares actual with targeted conditions.

35 Dashboard: Performance Reporting System for Projects and Programs, Virginia Department of Transportation, http://dashboard.virginiadot.org/

36 Organizational Performance Dashboard, North Carolina Department of Transportation, http://ncdot.gov/performance/

CHAPTER 4

Performance Measures and Targets

Performance measures and targets are critically important for making performance-based investment decisions. The information is used to set investment priorities, communicate needs to various stakeholders, and hold agency personnel accountable. This chapter summarizes the use of performance-based maintenance programs for budgeting and scheduling work activities. In addition, it describes how these programs are being used to set performance targets and introduces some of the challenges participating agencies face in using performance-based data to drive maintenance investment decisions.

Use of Performance-Based Maintenance Programs

The performance-based programs discussed during the scan represent different degrees of sophistication and a range of approaches for using performance data. It became evident from the peer discussions that the use of performance-based programs is evolving. For instance, FDOT indicated that maintenance performance targets are only set for assets that are fully funded. UDOT stopped monitoring mowing since performance data was not driving maintenance activities. Since UDOT mows everything at least once annually and several routes have safety-related prescriptive mowing, annual surveys were determined to be unnecessary. NCDOT stopped assessing litter and mowing because the need is based on number of cycles; it is not a snapshot of conditions. This chapter provides additional examples of how performance-based data is used to support maintenance budgeting activities.

Setting Maintenance Budgets and Priorities

North Carolina

NCDOT maintains one of the largest networks in the country, with nearly 80,000 route miles. NCDOT uses a proprietary maintenance management system (MMS) that is integrated with its pavement and bridge management program so all of the systems can share data. Each year, the divisions enter annual plans into the MMS, detailing what work will be accomplished in a given year. The divisions have the authority to decide how funding will be used and they are provided data from the MMS to assist with this activity[37]. There is no process for formally approving the divisions' annual plans; however, the chief engineer and the division engineers hold progress meetings quarterly to they discuss actual versus planned work. Their accomplishments are also displayed in the dashboard for the legislature and executive leadership to see. The Highway Maintenance Improvement Plan is approved by the board and NCDOT has to justify any planned work that is not completed. To date, this level of checks and balances has been adequate to ensure that sound decisions are being made and that available funding is being used wisely.

37 DOT personnel indicate it is not clear to what extent the data are used.

Wisconsin

In Wisconsin, the DOT[38] (WisDOT) contracts with the counties to do all maintenance work, so the department operates more in an administrative function for maintenance. WisDOT employs an Operations manager in each region to oversee maintenance and traffic operations. In addition, a regional maintenance coordinator works with the counties to do the MQA surveys for the DOT's Compass[39] maintenance management program. A representative group of state and county personnel participates in a Compass advisory team to ensure that the system continues to meet state and county needs.

The amount of funding available for WisDOT's non-winter maintenance activities is heavily influenced by the severity and duration of Wisconsin's winter storms. The Wisconsin legislature currently makes only one appropriation to the department for both winter and non-winter maintenance. WisDOT prioritizes the money needed to address snow and ice control; any funds remaining are allocated to summer maintenance.

Wisconsin's counties have flexibility in how they spend their money; however, information that shows the state's highest priorities is provided to them to help guide their decisions. The regional maintenance coordinator verifies that statewide directives are being implemented at the regional level, evaluations are used to verify that money is being spent as expected, and historical data is used to verify results as needed.

Florida

A task force developed FDOT's Maintenance Rating Program[40] (MRP) in the 1980s. It was first designed to evaluate maintenance conditions using a uniform procedure to identify maintenance needs and priorities. Each district is responsible for having at least one, two-person MRP team comprising either in-house personnel or consultants. FDOT has an MMS database that tracks the production, personnel, equipment, and materials that inhouse personnel use to maintain roads and rightsofway.

Since contract forces conduct approximately 90% of Florida's maintenance work, a separate program manages these contracts. For the most part, contractors are paid by pay items and a conversion is done to transform the pay items into the same units used in the MMS. Contractor bidding, contract management, and reporting are done using an AASHTOWare[41] program. An interface was developed to transfer the contractor data into the MMS once a week. Some asset management contracts make a contractor responsible for managing the maintenance activities necessary to achieve stated performance targets for all assets within the fenceline. These contracts are paid monthly on a fixed-price basis and the contractor is only required to submit work completed. Therefore, the DOT receives the units of work that are accomplished each month, but is unable to derive a cost per unit for this work. The agency is working on strategies to capture that information.

38 Wisconsin Department of Transportation, http://wisconsindot.gov/Pages/home.aspx

39 Compass, Wisconsin Department of Transportation, http://wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/compass/default.aspx

40 Maintenance Rating Program, Office of Maintenance, Florida Department of Transportation, http://www.dot.state.fl.us/statemaintenanceoffice/MaintRatingProgram.shtm

41 AASHTOWare™, American Association of State Highway and Transportation Officials,

In Florida, maintenance budgets are prepared based on the amount of work needed to reach the expected performance targets incorporated into statute through legislation. Unit costs are established in the MMS for each work activity and the districts apply the unit costs to their estimates of the number of units needed to achieve an MRP of 80 or above. These calculations are then submitted to the executive committee for approval. Fixed obligations are added to the budget for lighting utilities, bridge inspections, rest area facilities, and intelligent transportation system assets; however, there is no provision for adding assets to the system under this budget. Upon the executive committee's approval, Maintenance Schedule B is prepared summarizing the current year's state maintenance budget and the five-year projection.

The districts have other funding that is added to the state maintenance budget for their total working budget. The Districts have flexibility in how they use the available funds as long as they adhere to the rules. Each district also has an administrator to help ensure that the funds are administered appropriately.

The Florida Transportation Commission oversees the maintenance program and ensures that the maintenance goal is achieved. This goal is one of 17 goals that the commission reviews. FDOT reports that it has been able to meet the goal for at least the last 20 years.

Utah

As presented in a previous chapter, UDOT's MMQA+ program has been an important tool for budgeting and scheduling maintenance activities for several years. At the statewide level, the information from the MMQA+ program is used to communicate accomplishments and to show where resources should be placed during the budgeting process. At the station level, the MMQA+ data is used to prioritize and schedule work activities.

The allocation of funds under the Maintenance Hard Surface Program[42] can be used to illustrate how UDOT uses performance data in the budgeting process. State funds for this program are dedicated almost entirely to low-volume roads since the federal portion of the budget goes primarily to interstate and high-volume state-maintained highways. With a budget of about $21 million for state maintenance work, approximately $11 million is used for preventive work (e.g., chip seals and flush coats) and $10 million is used for surface repairs (e.g., pothole patching and crack sealing). The funding is allocated to the regions based on the number of miles of low-volume roads and the amount of reactive maintenance that is needed. However, UDOT is evaluating whether it could use its pavement management software to better identify low-volume road needs. For the higher-volume roads, the pavement management system gives the regions recommendations; the regions are required to match a certain percentage of the work. If the work is completed for a cost below what was budgeted, the regions retain the money for use on other regional priorities. This money is expected to allow the regions to address some of the system's unfunded ancillary needs.

42 Pavement Preservation Program, Fund Fact Sheet, Program Development and STIP, Utah Department of Transportation, https://www.udot.utah.gov/public/ucon/uconowner.gf?n=16019903714059021

Over time, changes to Utah's program have affected the use and administration of maintenance performance data. For instance, in recent years UDOT has created a dual role for maintenance and construction workers in contrast to the separate roles that were maintained in the past. The department has also seen changes to the performance measures that are being used. For instance, a new performance measure was recently developed for snow and ice removal and the DOT's efforts were recognized with an ITS America[43] award. During the development of its performance measure, the DOT discovered that many metrics for monitoring storms are available, but none indicate the conditions on the road. The resulting Utah Road Weather Index[44] considers snowfall rate, road conditions, road temperature, snowfall dryness, wind gusts, and the amount of freezing rain to represent the driving conditions a traveler will face.

Colorado

CDOT's Maintenance Levels of Service (MLOS) program provides work order details and current conditions. It houses the maintenance asset inventory and can project costs needed to achieve different targeted LOS. Historically, funding allocations have been based on past expenditures; however, the DOT has initiated a study to better align costs and performance to improve investment decisions using a zero-based budgeting approach.

Currently, funding needs for maintenance go through a Delphi Method where approximately 40 division directors, regional directors, and asset managers compete for funding. During this process, funding allocations are finalized through a voting system. After the process, the funding allocations are presented to the Transportation Commission[45] for approval. Budgets are set three years out and funding is allocated annually. Once the statewide maintenance budget is set, the MLOS administrator, in conjunction with the division director, allocates funds through the MLOS budget model. The budget model allocates funds to specific asset categories for each section and sets the expected LOS to be achieved for the specified budget year.

Historical ratings show that CDOT is consistently over-performing what is projected in maintenance. It has been an educational process to get personnel to understand that overperforming in one area may affect CDOT's ability to achieve other performance targets. This was one of the reasons that all front-line managers were trained through the National Highway Institute's Maintenance Leadership Academy[46].

Several aspects of CDOT's MMS will be updated to better support a performance-based budgeting process since the inventory is currently outdated (though it is being updated) and there is no process in place to ensure that construction information is entered into the database. CDOT is also revisiting its maintenance condition assessment survey methodology. Its current approach results in 15 different, unique grades, rather than the more traditional five grades (i.e., A, B, C, D, and F) and it is having a hard time keeping up with the number of surveys that are required each year.

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43 ITS America, Intelligent Transportation Society of America, http://www.itsa.org/awards

44 Rouse D, UDOT Winter Road Weather Index by Jeff Williams, Robert Clayton and Cody Opperman, September 24, 2015, TSM&O News, National Operations Center of Excellence, http://www.transportationops.org/blog/headline-news/udot-winter-road-weather-index-jeff-williams-robert-clayton-and-cody-opperman

45 Transportation Commission, Colorado Department of Transportation, https://www.codot.gov/about/transportation-commission

46 Maintenance Leadership Academy, National Highway Institute, Office of Technical Services, Federal Highway Administration, U.S. Department of Transportation, http://www.nhi.fhwa.dot.gov/training/course_search.aspx?course_no=134063&sf=1

Organizational changes at CDOT have affected the role of maintenance in the budgeting process. Approximately two years prior to the scan, CDOT changed its organizational structure. At that time, Highway Maintenance was raised to a division level reporting directly to the deputy director/chief operating officer. At the same time, Emergency Operations was placed in a separate division, called the Office of Emergency Management. The raised profile for maintenance provides it a seat at the table to present its funding needs to the Transportation Commission as part of the agency's Asset Management Program.

Arizona

ADOT launched a needs-based performance model for maintenance budgeting in FY2015, which helped move the agency away from a historical-based budget allocation. The results from this process have been used to make necessary adjustments to the process; the modified approach will be used for FY2017. As the DOT shifts toward a needs-based budgeting process, the district offices are seeing the importance of having a current inventory, accurate cost data, and a reliable LOS program. ADOT noted that the emphasis on performance-based budgeting is a culture change for the organization, which will take time to be fully accepted. It currently sets targets for about 45% of its maintenance activities, but expects to increase that number in the future.

Impacting Funding Levels

Many states continue to allocate funding to districts based on inventory and past expenditures, rather than on condition, even if MQA data is available. This is often due to a lack of confidence in the data.

- **Mississippi DOT** indicated that budgeting is gradually moving from a vehicle-miles-traveled/historical format toward an entirely needs-based sub-allocation approach for routine maintenance funds. However, many within the agency are still not convinced that the data can be relied on exclusively at this point. The department currently distributes the maintenance budget using a formula based 40% on need and 60% on vehicle miles traveled.
- **NCDOT** reports that state legislators initiate a number of fund directives without appearing to trust the data provided by maintenance. For example, recent state legislation directed the number of miles of certain types of treatments that NCDOT must construct in a year.
- **TDOT** has ongoing concerns with the data's integrity and continues to rely on historical expenditures and inventory to request funding.

As evidenced by the previous examples, most of the state agencies participating in this scan use MQA data within maintenance to help track activities, prioritize needs, and/or allocate funding. However, states that have provided ongoing training to governing bodies, used the data to communicate budget impacts, and are held accountable for results have seen higher investment levels in maintenance activities.

FDOT was the only participating agency that indicated it has adequate funding levels to support its maintenance targets. WisDOT's budget was recently increased by an additional $50 million for maintenance based on its MQA program, budgeting model, and its ability to hold itself accountable for how its LOS scores are tied to the level of funding.

Using Performance Data to Set Maintenance Targets

Several of the participating agencies use performance targets to improve both agency and personnel accountability for the decisions they make. While most of the participating agencies reportedly use performance targets as a way of reporting funding needs, far fewer agencies feel confident enough with their data to hold individuals accountable for achieving performance targets. In agencies where performance data is used to hold individuals accountable, scan participants stressed the importance of setting performance targets that can be achieved with the available funding and resources. The following examples of practices associated with setting maintenance performance targets are provided to illustrate the range of approaches the participating agencies use.

Florida

FDOT's is the simplest approach to target setting since a single maintenance performance target is legislated at the statewide level. The current target, which requires the DOT to achieve 100% of the MRP rating of 80 on the state highway system, and the size of the district inventory drive the funding levels provided to each district.

Mississippi

Some performance expectations are set by the legislature for Mississippi DOT (e.g., $80 million on overlays, mow 300,000 acres). However, these are not necessarily tied to certain LOS; instead, they are tied to legislative priorities. The department sets maintenance performance targets, but they are more representative of desired LOS if adequate funding were provided, rather than realistically achievable targets. The maintenance performance targets, expenditures, and annual condition assessment the DOT establishes are shared with commissioners and administration in an annual maintenance summary report. However, there is minimal discussion related to how the targets were derived.

Utah

At UDOT, maintenance targets for each of the 16 assets measured in the field as part of its MMQA+ program are now set by arbitration. A committee that includes senior leadership discusses the level of effort that it wants to put into each activity, public perception, and the funding level that is needed to achieve that LOS. A technical team and executive leadership, both internal to UDOT, ratify the targets.

Arizona

ADOT allows the districts to recommend performance targets and priorities for maintenance activities based on unconstrained needs and local conditions. The proposed targets and LOS information are presented to the state engineer to negotiate final targets for each district. Once the final targets are established and the budget is allocated appropriately, the district engineers are responsible for managing their maintenance shops (called units in Arizona) to the appropriate level. District engineers are expected to manage their resources and associated funding appropriately to meet the established targets.

North Carolina

NCDOT authorizes its divisions to determine how funding will be used for maintenance activities and provides MQA data to assist with this activity. Division engineers submit annual plans that identify what work will be done; these plans are reviewed quarterly with the chief engineer. The district engineers are held accountable for their performance, since their planned and actual performance data are incorporated into their annual evaluations.

Wisconsin

WisDOT uses a grading approach for maintenance activities, with different priorities for activities ranging from safety to aesthetics. Targets are based on the funding levels received so they do not reflect an optimal maintenance condition for the highways. Available funding is distributed to regions and counties based on infrastructure inventories in a budgeting model and through a routine maintenance agreement. The actual amount distributed by the budgeting model is based on a ratio of the county's needs divided by the entire statewide backlog needs; the result is multiplied by the amount of available funding. In this way, all counties receive the same reduction. In 2016, the needs reduction was approximately 78%.

Figure 4.1 shows a portion of the information provided to the regions; specifically, it shows historical highway maintenance targets for non-winter activities. The circles represent targets that either were not met or were exceeded and the arrows represent targets that were adjusted upward or downward. Targets are not set for certain portions of the highway expenditures, such as winter operations, certain traffic control devices, and electrical operations.

Contribution Category and Element	Feature	2011 Target Percent Backlogged and Feature Grade - Statewide	2012 Target Percent Backlogged and Feature Grade - Statewide	2013 Target Percent Backlogged and Feature Grade - Statewide	2014 Target Percent Backlogged and Feature Grade - Statewide	2015 Target Percent Backlogged and Feature Grade - Statewide	**2016 Target Percent Backlogged and Feature Grade - Statewide**
Critical Safety:							
Traffic and Safety	Reg./Warning Signs - Emergency Repair	0=A	0=A	0=A	0=A	0=A	0=A
Shoulders	Hazardous Debris	6=C	6=C	5=B	5=B	5=B	5=B
Traffic and Safety	Protective Barriers	3=B	3=B	3=B	3=B	3=B	3=B
Traffic and Safety	Centerline Markings	5=B	5=B	5=B	5=B	5=B	5=B
Traffic and Safety	Edgeline Markings	8=C	8=C	8=C	8=C	8=C	8=C
Shoulders (unpaved)	Drop-off/Build-up	30=F	30=F	30=F	30=F	28=F	28=F
Shoulders (paved)	Drop-off/Build-up	4=B	4=B	4=B	4=B	4=B	4=B
Safety/Mobility:							
Roadside	Woody Veg. Control for Vision	2=A	2=A	2=A	2=A	2=A	2=A
Roadside	Mowing for Vision	5=B	5=B	5=B	5=B	5=B	5=B
Traffic and Safety	Special Pavement Markings	23=D	23=D	10=C	10=C	10=C	10=C
Roadside	Woody Vegetation	5=B	5=B	5=B	5=B	5=B	5=B
Drainage	Culverts	30=D	30=D	30=D	30=D	30=D	30=D
Drainage	Storm Sewer System	15=C	15=C	15=C	15=C	15=C	15=C
Shoulders (unpaved)	Cross-Slope	30=D	20=D	20=D	20=D	18=C	18=C
Traffic and Safety	Delineators	25=D	25=D	25=D	25=D	25=D	25=D
Traffic and Safety	Reg./Warning Signs -Routine Replacement	25=D	25=D	15=C	15=C	9=B	9=B
Roadside	Fences	14=C	14=C	14=C	14=C	14=C	14=C

Figure 4.1 WisDOT non-winter highway maintenance targets

Not Using Performance Data to Set Maintenance Targets

As in Wisconsin, several other scan participants identified maintenance activities for which performance targets are not set. These activities typically represent elements that are not driven by performance, are outside the control of maintenance personnel (e.g., mowing and litter), or are not adequately funded.

Mississippi DOT mentioned that although it has performance targets for mowing and litter, it is considering eliminating them because of seasonal condition variances and because mowing is not a priority. NCDOT indicated that some things are funded "off the top" to address agency priorities rather than performance targets.

In several of the participating states agencies, performance targets are not linked to investment levels since the amount of funding available is not adequate to do so. For example, TDOT reported that it does not have a specific performance target for bridges; however, each year the central office attempts to replace the bridge deck area of bridges that are projected to become deficient. For pavements, a performance target is only set for interstates (i.e., 95% meets standards), but funding is not sufficient to meet the standard.

Adjustments to Make Better Use of Maintenance Performance Data

Several scan participants indicated that they would like to strengthen their use of performance data for maintenance budgeting and allocation activities. For example, Mississippi DOT would like to build accountability into its MQA program so the districts are held to the work accomplishments outlined in their work plan. However, this will require the DOT to have more confidence in the data at the district level. NCDOT indicated that it only recently believed that it had the ability to hold managers accountable for planned versus actual expenditures.

CDOT is updating its program to better align maintenance cost and performance data so it is better able to set performance targets. Historically, the allocation of maintenance funding was based on past expenditures; the agency intends to move away from that process. CDOT is initiating the changes that are needed to support this goal, including updates to its asset inventory, revisions to the maintenance condition assessment surveys, and reductions in the number of grades being used.

WSDOT has also adjusted the way it reports LOS information. At one point, its MAP program had a single, rolled-up, statewide LOS rating. However, the agency decided that the statewide rating did not really have any meaning and diluted the real needs. WSDOT now reports on each of the assets since people seem to understand this more readily. In a more recent change, the DOT moved away from letter grades that included plus and minus signs, since it implied a level of precision that didn't exist and called into question the recognizable differences between a C+ and B-, for example. The DOT now uses whole-letter grades to report conditions.

Inventory and Condition Assessment Data

Performance-based decisions rely on the availability of sound, credible information. The degree to which data is used to make investment decisions is strongly related to the degree of confidence that managers have in the data. Because of the importance of data and the demand on resources associated with these activities, the scan team found that several agencies have initiated efforts to streamline their data collection efforts. This chapter highlights some of the data collection activities that are being used to support MQA programs as well as the innovative ways technology is being used to support data collection and analysis.

MQA Inventory and Condition Assessment Practices

Inventory and Condition Assessment

Utah

Data for UDOT's MMQA+ program is collected twice a year, with the exception of more frequent measurement for snow and ice as well as rest area maintenance. Maintenance station personnel conduct inspections of each route segment and record both the total number of features to be maintained and the total number of deficient features. Figure 5.1 is an example of a page from the UDOT MMQA+ Inspection Manual that the inspection crews use. Based on the data recorded, a Level of Maintenance is calculated and a letter grade (i.e. A, B, C, D, or F) is reported. Central maintenance performs data quality checks and audit results using randomly selected samples.

3A2 – Curb and Gutter

Description:	A measure of the functional condition of curbs and gutters, (concrete or asphalt), on state routes.
Desired Condition:	Curb is intact and allows for proper drainage.
Deficient Condition:	Curb does not allow for proper drainage due to upheaval, misalignment, broken or severely cracked sections.

Reporting Guidelines:

Frequency:	Semiannual
Measurement Area:	All UDOT-maintained roadways / roadsides.
Deficiency:	Record the total length in feet of curb and gutter sections that do not allow for proper drainage due to upheaval, misalignment, broken, or severely cracked sections. In these reported sections, water may be allowed to drain behind the curb or underneath the roadway.
Total:	Report the total length in feet of curb and gutter along each route or route segment. Include curb and gutter along both shoulders, but not along raised islands.
Comments:	Moderate spalling or flaking is not necessarily deficient. This evaluation does not include conditions relating to the sweeping of curb and gutter.

Examples:

Desired Condition
(Curb intact and functioning properly).

Deficient Condition
(Curb is broken).

MMQA+ Inspection Manual 13 *Revised July 2012*

Figure 5.1 Example page from the UDOT MMQA+ Inspection Manual

Quality assurance audits are scheduled in the spring and fall so that each station is audited once every year. After the audit is completed, the quality assurance team meets with the station supervisor to review the results and prepare a report for the area supervisor. The quality assurance activities are considered a training opportunity rather than a faultfinding mission. The central maintenance audits are considered an important step in calibrating the inspection crews statewide.

Wisconsin

WisDOT's Compass program relies on the results of visual, walking inspections for its condition assessment of randomly selected 1/10-mile samples. The counties are responsible for collecting the data for 28 different maintenance features using two-person crews that evaluate either pass/fail characteristics or maintenance deficiencies, depending on the maintenance feature. The inspection results are converted to letter grades (i.e., A, B, C, D, and F) so the DOT can effectively communicate with stakeholders who are not as familiar with other rating scales. The central office conducts random checks on six segments in 10 counties for quality purposes.

The results from the quality checks are used to improve the content of the annual Compass training sessions by focusing on inspection procedures that are not being done consistently across the state. Figure 5.2 is an excerpt from the WisDOT 2015 Compass Rating Sheet. Figure 5.3 is an example of how Compass is presented to stakeholders.

Shoulders	Standard	Value	Comments
Hazardous Debris (S-1)	Number of items large enough to cause a safety hazard.....		
Paved Shoulder	☐None (If none, skip to Unpaved Shoulder)		
	Paved shoulder width (typical width in whole feet).....		
	Paved shoulder length (total linear feet).....		
Drop off/ build-up (S-2)	Linear feet of paved-to-paved drop-off/build-up greater than 1.5".....		
Cracking (S-3)	Linear feet of unsealed cracks greater than ¼" (up to 150' on undivided highways or 300' on divided highways).....		
Potholes/ Raveling (S-4)	Total sq. ft. of BOTH potholes AND raveling greater than 1 ft² x 1" deep.....		

Figure 5.2 Excerpt from the WisDOT 2015 Compass Rating Sheet

Figure 5.3 A page from a WisDOT introductory handout on highway operations

Tennessee

TDOT contracts with a vendor to build its maintenance inventory (excluding cross-drainage structures) using vans outfitted with lasers, cameras, and light detection and ranging (LiDAR). The department collects information on the interstate and the national highway system annually; it collects the remainder of the system every other year. Each time the data is collected, the new inventory replaces the previous data set and differences are identified. In addition, district staff members conduct monthly inspections on 1/10mile segments to determine a maintenance rating index. This index is a pass/fail rating approach that evaluates pavements, shoulders, roadside assets, drainage, and traffic services. Districts are expected to meet an 85% index rating. Most are passing; the average score is approximately 88%.

North Carolina

NCDOT conducts MQA assessments throughout the year and reports quarterly. Two-person teams comprising NCDOT employees and contracted employees conduct the surveys. At the time of the scan, six of the 14 districts contracted out their data collection activities. Sections to inspect are randomly selected 1/10-mile samples. To attain a 90% confidence level with a 5% margin of error, the DOT assesses 22,000 sections annually at a cost of about $2 million. During the surveys, inventory information and a deficiency quantity are recorded for 11 different elements. The information is entered into a tablet computer with global positioning system functionality.

Florida

The availability of a comprehensive maintenance inventory and the development of maintenance schedules at FDOT allow the separation of maintenance budgeting activities from condition reporting. District personnel are assigned responsibility for maintaining an inventory consisting of an asset count; and no data in the inventory is allowed to be more than five years old. For new construction projects, the inventory must be updated within 90 days. These requirements have led to a high degree of confidence in the numbers used for budgeting purposes. FDOT is now considering expanding the inventory to include unique asset characteristics and location information.

Performance monitoring is used primarily for accountability purposes. Processes are in place to verify that inventory and performance data have been checked. If a mistake is found, a supervisor sends an e-mail message to the person responsible for that information so that he or she sees the link between data quality and accountability.

Data Quality

The focus of many agencies' MQA programs has been on collecting data, with less emphasis on the accuracy and impact of the results. In some cases, states reported that their confidence in their MQA data varies based on the type of data. For instance, NCDOT indicated that it has less confidence in expenditure and activity data than in its condition data, which it considers quite reliable. Mississippi DOT reported that some of the assumptions about inventory extrapolation and activity distribution being made in its MMS affect the department's confidence in the numbers provided.

Rater training is commonly used to ensure consistency in the condition data collected across the state. For example, both FDOT and WisDOT reported that they have strong training programs in place. WisDOT indicated that its training program is an important source of information for needed changes to the rating process to make it more reliable. UDOT relies on rater training to ensure data quality and no longer conducts field checks of the data collected by raters. It also named specific individuals to data collection teams to improve coordination and data quality. WSDOT uses its training program to calibrate the raters, but relies on quality assurance checks by headquarters staff on 10% of the rating segments to ensure quality.

Cooperative Approaches to Data Collection

To reduce redundancy in data collection efforts, a number of agencies reported that they are using data from other sources to support their MQA programs. For example, WSDOT eliminated redundancy in its data collection efforts by deciding to use pavement management data on roadway conditions rather than have maintenance collect pavement condition data separately. UDOT is using pavement management data for its hard surface maintenance condition assessment program.

Using Technology to Improve Practices

Technology is being utilized to increase data collection efficiency and accuracy. At WSDOT, this effort has led to the dissemination of 939 iPads across the regions. UDOT and TDOT have used automated data collection vans with LiDAR, and the data is being used for purposes beyond maintenance.

WSDOT is also taking advantage of other surveys (e.g., pavement management surveys, drainage inspections, and bridge inspections) to support its MAP efforts. It has been able to reduce the number of activities that are evaluated during the annual surveys from about 28 to 14.

UDOT has initiated several examples of using technology to improve practices. For example, it is piloting an MMQA+ field collection tool with mapping features that is built into an iPad. UDOT is also using meteorologists' reports to track weather-related roadway conditions and make decisions about allocating resources in a weather event. Figure 5.4 is an example of the screen used to monitor the winter maintenance performance metric.

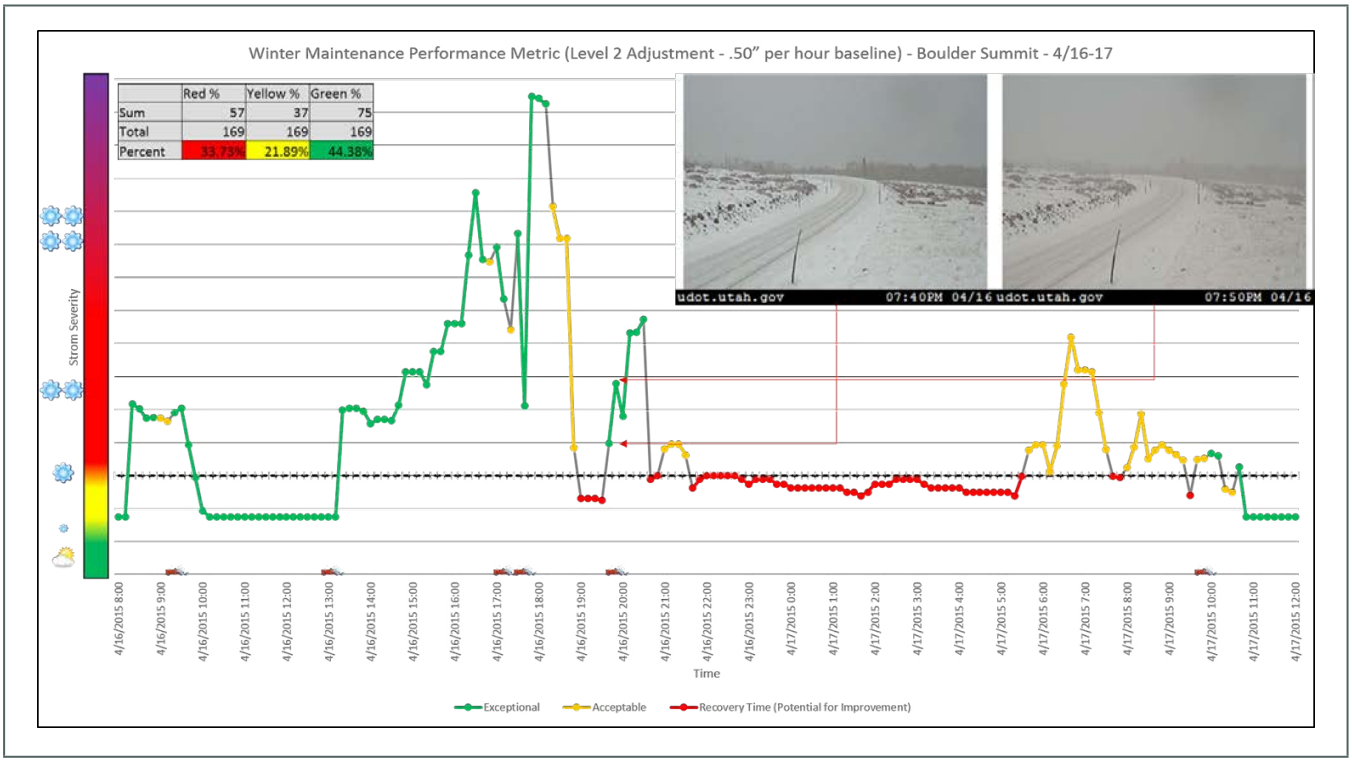

Figure 5.4 Example UDOT screen for monitoring winter maintenance performance metric

Maintenance Program Support

Agencies that have adopted a performance-based program have business processes, software tools, and other resources available to support their efforts. As discussed earlier in this report, the scan team found that both Category 1 and 2 states use MQA programs to monitor maintenance accomplishments; however, their approaches, resource requirements, and levels of confidence in the results vary. The scan also found innovative uses of technology and personnel to support their maintenance efforts, which are introduced in this chapter.

Interesting Uses of People and Technology to Support Maintenance

This scan uncovered several examples illustrating how different state agencies are utilizing people and technology to effectively support their maintenance programs and meet performance goals. For example, UDOT assigns a business analyst to work with each region to make sure they manage within their given budgets. This person is responsible for reviewing annual budget requests from the regions and defending the budgets during the budgeting cycle. To facilitate this activity, the business analyst uses performance data to discuss the budget requests with the regions, validating or questioning funding requests based on previous performance. UDOT prefers that individuals in these positions have an accounting or finance degree, but a background in maintenance is helpful. ADOT also employs financial analysts to support maintenance budgeting activities.

For its MQA program, UDOT is currently piloting a field data collection tool that operates on iPads with 3G connections so the agency has no monthly data fees. The program will feed data directly into the DOT's MMS, where performance ratings will be calculated from the data.

WSDOT also uses iPads to support its MQA activities. The agency recently purchased iPads for every maintenance technician in the field, resulting in an estimated 939 iPads in the field. Technicians are now able to collect and record condition data and build up the inventory using this tool.

The availability of programmers to support MQA activities has made a difference in several agencies. For example, WSDOT maintenance personnel worked closely with an in-house programmer assigned to maintenance to develop a map-driven data collection tool intended to increase the efficiency and quality of data collection efforts. The program is currently being used only for inventory and recording maintenance work completed; however, the goal is eventually to use it for entering time and equipment information.

ADOT maintenance personnel have access to programmers to work on their homegrown MMS. The programmers dedicated to ADOT's maintenance team are paid from a DOT-funded IT group, so they do not affect the maintenance budget.

Many of the participating states have proactively established business processes that require districts to spend a certain amount of money on preservation activities to help ensure that these treatments are used effectively. For example, VDOT has set a priority to fund maintenance first. TDOT has guidelines that a minimum of 10% of funds have to be used on preservation projects

at the district level. The TDOT pavement management system can be used to suggest strategies and the remaining service life expected to be added back to the system through the selected treatments. Districts are also expected to achieve a certain number of lane-mile years with their program. Mississippi DOT has mandated that 10% of maintenance funding allocated to the districts must be used for pavement preservation.

There are many other examples of state transportation agencies with business processes in place to support the use of preservation activities. For instance, FDOT requires that any deficient bridges must be programmed for repair or replacement within five years after receiving a deficient rating. MaineDOT emphasizes the use of quick, efficient, and effective preservation activities by requiring all regions to plan at least 80% of their work a year in advance, specifying either project location or activity. Regions are then measured on whether they meet goals to perform 80% of the work within the calendar year and spend ±20% of the funding allocated to that project or activity.

For UDOT's hard surface program, a certain percentage of the recommendations from the pavement management system must be matched to projects on interstate and Level 1 roads. To ensure that preventive maintenance treatments are applied, WSDOT has implemented a one-touch program that requires at least one maintenance application to extend pavement life before any preservation funds can be spent. The program is in place for pavements and a similar concept is being extended to bridges. The process has helped to force personnel to work together and overcome organizational silos.

Since unexpected snow- and iceremoval events can divert funding from other planned maintenance activities, some state DOTs have developed funding strategies to minimize the impact. For example, at UDOT, funding for unplanned emergencies is recoverable so the regions are paid back immediately while the state waits for repayment. Each region also has a small contingency fund that can be used.

ADOT is implementing a heavy automated motor pool in each district that "rents" equipment that did not have high utilization rates at the unit level. Online programs allow maintenance personnel to view and reserve available equipment. The equipment is serviced in designated service shops. Any equipment that is unused at the district level rolls up to a higher level, eventually leading to a state rental unit.

Finally, WSDOT is projecting that up to 50% of the workforce will be eligible for retirement in 2019, representing 71 to 85% of the supervisory staff. As a result, the department is facing significant leadership transition challenges. For maintenance staff, WSDOT has instituted a maintenance operations leadership series that starts with new employee orientation and several stages of training throughout their career that will lead to promotions at the "journey, forum, and summit levels," as shown in Figure 6.1.

Figure 6.1 WSDOT training levels

Key Findings

This scan provided an opportunity for the scan team to investigate the current practices used by the 12 participating state transportation agencies to determine and allocate funding levels for maintenance and preservation. The key findings from the scan are presented within the following topic areas:

- **Agency Culture** – The scan team observed that the culture within the Category 1 states embraced performance-based management at all organizational levels. As a result, agency personnel understand how investment decisions are made, that individuals are held accountable for achieving performance targets, and that a high priority is placed on the availability and use of data and analysis tools.
- **Relationship with Elected Officials** – The scan team observed that each of the Category 1 states has established a strong relationship with elected officials. This relationship appears to be grounded in a level of trust that the agency is managing effectively. This has led to positive results when negotiating for maintenance funds.
- **Performance Measures and Targets** – Performance measures and targets are critically important for making performance-based investment decisions. The information is used to set investment priorities, to communicate needs to various stakeholders, and to hold agency personnel accountable. For maintenance, one state indicated that performance targets are only set for assets that are fully funded. In another example, UDOT stopped monitoring mowing since performance data was not driving maintenance activities. Since UDOT mows everything at least once annually and several routes have safety-related prescriptive mowing, annual surveys were determined to be unnecessary. NCDOT stopped assessing litter and mowing because the need is based on number of cycles; it is not a snapshot of conditions.
- **Inventory and Condition Assessment Data** – Performance-based decisions rely on the availability of sound, credible information. The degree to which data is used to make investment decisions is strongly related to the degree of confidence that managers have in that data. Because of the importance of data and the demand on resources associated with these activities, the scan team found that several agencies have initiated efforts to streamline their data collection efforts.
- **Maintenance Program Support** – Agencies that have adopted a performance-based program have business processes, software tools, and other resources available to support their efforts. The scan team found that both Category 1 and 2 states use MQA programs to monitor maintenance accomplishments; however, their approaches, resource requirements, and levels of confidence in the results vary. The scan also found innovative uses of technology and personnel to support the agencies' maintenance efforts.

The observations that were made in support of each finding are summarized in the following sections.

Agency Culture

Finding 1: The culture within Category 1 agencies fully embraces perfor mance-based management at all organizational levels.

A fundamental scan finding focused on the agency culture in the three Category 1 DOTs. Agency culture is a hard concept to describe. For the purposes of this discussion, culture is defined as the predominant attitudes, values, and practices that distinguish one state agency from another. An agency's culture is reflected in its internal and external communications, policies and priorities, business practices, and organizational decisions. An agency culture that strongly embraces performance-based management is a distinct feature of the Category 1 agencies that participated in the scan. These three agencies have the following characteristics:

- Everyone is on board, from upper management to maintenance technicians.
- Agency personnel can explain the organization's goals and priorities.
- Stakeholders, including maintenance personnel, have a place at the table to determine maintenance funding levels.
- The agency shows it is committed to performance-based management through word and action.
- Personnel are held accountable for achieving performance objectives.
- Resources are provided that assist with achieving the goals.
- Data drives funding decisions rather than historical allocations or practices.
- Continuous improvement is a mantra. Progress is reported regularly and feedback solicited so improvements can be made at all levels.

Relationship with Elected Officials

Finding 2: The Category 1 states and several Category 2 states have established a strong relationship with elected officials based on trust in agency decisions.

Establishing and maintaining a productive working relationship with state legislators was another key feature of Category 1 states and several Category 2 states. Relationships deemed productive are characterized by a give and take of information, mutual trust, and regular communication. Agencies that have productive working relationships with their state legislatures can respond quickly to requests for information or identification of needs. The legislators have confidence in the information their DOT provides them and in the DOT's ability to meet performance targets based on the funding provided.

DOTs that have a good working relationship with their state legislatures recognize the ongoing

effort that is required to establish and maintain that relationship. These DOTs work to educate new members of the legislature on how they establish and prioritize funding needs. They communicate regularly with the state legislature on their progress, making the information both meaningful and useable to the representatives. These DOTs also use the opportunity provided by these regular communications to explain anomalies or anticipate issues before they arise.

Performance Measures and Targets

Finding 3: Performance measures and targets are needed to link investments with results.

Finding 4: Performance targets should be achievable with available funding and resources.

Maintenance performance measures are used to show the results of asset investments to executive leadership and to establish maintenance priorities for field personnel. Targets are often set based on funding available, statewide priorities, and customer expectations. Maintenance categories typically are prioritized, and those priorities are reflected in the targets that are set. Safety assets, for example, typically have the highest targets, while activities associated with aesthetics typically have lower targets associated with them.

Performance targets support budgeting discussions at both the statewide and district/regional levels. At the statewide level, performance targets drive the investment levels for funding maintenance. Once the maintenance budget is set, funding is allocated to the regions and districts based on the number of assets they maintain, the number of assets that must be addressed to reach their performance target[47], or some other factor.

One of the challenges that agencies discussed during the scan was getting maintenance personnel to understand that exceeding a performance target is not desirable. Although most maintenance personnel pride themselves on the quality of their work and would much rather receive an A on their MQA scores, funding is usually not sufficient to fund maintenance activities beyond the targets on a statewide basis. This has been a cultural lesson that agencies have had to work on with their staff, shifting the attitude from getting the highest possible score to achieving the target.

Inventory and Condition Assessment Data

Finding 5: The degree to which data is used to make investment decisions is strongly related to the degree of confidence that managers have in the information available to them.

Finding 6: Because of the importance of data and the demand on resources as sociated with these activities, several agencies have initiated efforts to streamline their data collection efforts.

Data is the foundation on which a performance-based management system rests. However, to be successful, data needs to be accurate and reliable, and all stakeholders need to have confidence in

47 This is only possible is there is a good inventory of all the assets that the funds will be used to maintain.

that data. As states make the transition from using historical expenditure information to performance-based data to predict and defend budget needs, they are making decisions about what and how much MQA data to collect, which methods of data collection to use, and how to ensure that the data collected is of the desired quality level.

When there is a high level of confidence in MQA data, maintenance personnel can conduct analyses and communicate reliably with upper management, the legislature, and the public about performance. A significant level of confidence in MQA data allows agencies to use the information more broadly, and decision-makers can trust the information they receive and use it with confidence to make funding allocation decisions. Although most of the states that participated in the scan were collecting MQA data, there was significant variation in the levels of confidence in the data and, as a result, significant differences in how the data was being used.

The scan also found that several state transportation agencies are streamlining their data collection activities and integrating data usage to increase efficiency and reduce redundant and nonessential data collection tasks.

Maintenance Program Support

Finding 7: Performance-based organizations have established business processes, implemented software tools, and used available resources creatively, to support their programs.

Adequate program support extends beyond just funding. Agencies that have adopted a performance-based program have business processes, software tools, and other resources available to support their efforts.

Recommendations

Recommendations were developed from the key findings identified during the scan. The scan team organized these recommendations into several specific activities to promote and facilitate the use of performance-based management practices to determine funding levels for maintenance and preservation. The recommended activities are described below.

Establish Performance Measures and Targets That Drive the Development of a Unified Agency Culture

Consistently demonstrated across Category 1 state DOTs was a culture that supported performance-based management at all levels of the organization. Performance data was used to communicate funding needs to elected officials and to show that available funds were being used effectively. These organizations use performance data to drive funding allocations to the regions/districts rather than relying on historical allocations that do not reflect need. Performance measures are established to support these activities, institutionalize agency priorities, build agency and individual accountability, and create a culture that emphasizes transparency. Within this culture, agency personnel know what is expected of them and how their success is being measured. Information is regularly shared internally and externally to monitor progress and establish or maintain credibility with various stakeholders. While funding is typically not sufficient to address all of an agency's needs, the agency has a clear vision of what can realistically be accomplished and communicates that vision using achievable performance targets that reflect constrained funding.

By establishing effective performance measures and establishing the DOT culture around them, the agency is able to:

- **Support investment decisions**
  Funding allocations for maintenance are based on need rather than historical funding levels. As a result, agency priorities are addressed, and there is a high degree of confidence that performance targets based on available funding will be achieved.
- **Set priorities using a consistent, explainable methodology**
  Priorities no longer seem haphazard or based on the whim of political forces.
- **Explain the impact of different funding levels on performance**
  By establishing clear links between funding and accomplishments, an agency is in a better position to communicate funding needs and convey the impact that funding increases or decreases can be expected to have on LOS.
- **Build trust with the legislature**
  The agency can clearly state its goals, what it needs to meet them, and how it will measure its progress toward meeting its goals. The legislature knows what it can expect based on the funding provided and can monitor progress and make sure funds are being used as intended.

- **Align everyone in the organization**
  All employees know what the agency is working to achieve and can explain how their roles and responsibilities support the goals. This unifies employees, transcending the traditional silos that divided different teams, departments, regions, and districts.

- **Establish an effective data collection and analysis plan**
  Rather than collecting vast amounts of data with no clear purpose, data collection and analysis efforts are focused on accurately establishing and explaining the current condition of the agency's assets, where that condition needs to be to meet the performance goals, and the level of funding required to reach those goals.

- **Improve communications and hold itself accountable**
  By establishing performance goals, the agency can communicate to all stakeholders what work it intends to do with the funding provided and how such decisions were made. The agency can also report regularly on its success and explain instances where goals were not met.

After Establishing the Agency Performance Measures and Targets, Allow Regions and Districts Flexibility in Planning Work Activities

A foundational pillar of performance management is accountability at both the agency and individual levels. After they had established performance measures and targets, several agencies demonstrated the benefits of establishing a culture in which regions/districts were provided flexibility in developing their work plans in accordance with agency-defined performance targets. Various methods were in place to ensure that agency priorities were addressed, including audits, central office review of the work plans, and the use of a central-office maintenance coordinator. By establishing a culture that provides a balance between responsibility and accountability, agencies are able to:

- **Manage expectations in terms of performance rather than pots of money**
  This results in a necessary transition in the way business is done, shifting from the traditional focus on managing money to include a focus of equal importance: managing work activities.

- **Set attainable goals**
  The regions and districts are in the best position to know where money needs to be assigned to meet the required performance goals. They also need the flexibility to address changes in the condition of the assets or environment that could affect targeted LOS.

- **Transmit the performance-based management culture to the regional and district levels**
  Aligning regional and district-level goals with the agency's performance goals reinforces the agency's performance-based management culture, and it becomes the established mode of doing business at all levels within the agency.

- **Establish and maintain credibility with communities**
  Regions and districts can explain to the communities they serve what they intend to do and how they intend to do it. They are able to regularly share progress and explain challenges to success. This transparency builds confidence and trust between customers and the agency.

- **Invest in tools and technology that allow for greater efficiency**
  Regions and districts that demonstrate their ability to use resources effectively make the case for additional investments in tools and technology that can increase efficiency and improve results.

Develop Customer-Driven Targets to Convey Need and Achievable Targets for Accountability

Agencies use their targets to tell a story to the public and the legislature. The targets help explain what work was done, the impact of that work on the network's overall condition, and what can be done in the future at various funding levels to maintain or improve the system. Targets also help the agencies to plan by establishing current and expected levels of service.

The participants in the scan demonstrated that performance targets should reflect factors that resonate with the traveling public and elected officials. However, for accountability purposes, the performance targets should be set at a service level that is realistic and achievable with the funding level provided. Aspirational goals, which set desired conditions unencumbered by funding limitations, serve an important role in communicating funding gaps to stakeholders; however, they cannot be used to foster accountability. Establishing customer-driven and achievable targets allows an agency to:

- **Be held accountable and show how LOS is tied to the level of funding**
  The target should be achievable with the funding provided, and the agency should be able to communicate how the LOS will change with different levels of funding.
- **Hold managers accountable for the decisions that are made and the LOS attained**
  In an organization with a strong performance-based culture, agency managers should welcome the responsibilities associated with their position and expect to be held accountable for the decisions that are made. This balance between responsibility and accountability is critical to ensure that agency goals are achieved.
- **Track and communicate progress and validate priorities**
  Data can be used to ensure that spending is supporting agency priorities and to make necessary adjustments when unexpected events occur. To foster accountability and transparency, agencies should regularly communicate maintenance accomplishments to both internal and external stakeholder groups.

Develop National Guidance on Data Quality, Governance, and Utilization

A key scan finding focused on the level of confidence that agencies had in their performance data and its influence on how extensively the data was used to make investment decisions. Differences in data collection methodologies and procedures among the states significantly influence the level of confidence in the data and its usefulness for making investment decisions and holding employees accountable.

As demonstrated during the scan tour, the 12 participating state DOTs represented a range of MQA data collection approaches. For instance, some of the approaches use automated data collection processes featuring LiDAR, while other states use manual processes to collect the data. Most of the states inspect representative samples to reflect statewide conditions, but the number of samples inspected varies dramatically. Additionally, the scan states represented a number of different approaches to manage data quality and to keep the asset inventory current.

Based on the scan's findings, data issues appear to be a significant obstacle that could hinder agencies' ability to adopt the Category 1 states' practices without national guidance in the following areas:

- **Data collection procedures,** including the determination of the number of samples that are needed to use data for investment decisions and accountability purposes at different levels of the organization.
- **Quality management**, to identify processes and procedures that result in high-quality data collection efforts that can be used to support maintenance investment decisions.
- **Innovative uses of technology**, highlighting some of the innovative ways that maintenance personnel have overcome data collection challenges using technology.
- **Data governance**, to help ensure consistency in the data collected, to establish data collection protocols for each type of data, to define roles and responsibilities for data management, and to map links to all users of the data.
- **Data usage**, including examples of how performance data can be used to support investment decisions at different levels of complexity.

CHAPTER 9

Implementation Strategy

The scan team developed an implementation plan that will help promote the scan's findings and advance its recommendations. The plan includes two types of activities: those that advance the scan's findings through dissemination of information and those that advance the state of the industry through the development of guidelines and products that lead to the implementation of practices that better position maintenance agencies to secure sustainable funding levels. Examples of both types of activities are provided in the following sections.

Dissemination Activities

The advancement of the scan findings will be accomplished through the following dissemination activities:

- **Post scan products (or links to these products) on maintenance-related websites**
  The scan team recommends that links to the scan report be posted on relevant websites, such as the AASHTO Subcommittee on Maintenance's[48] (SCOM) site, AASHTO's Transportation Asset Management Portal[49], and the regional maintenance groups' sites.

- **Conduct a series of webinars to promote the scan's findings**
  With support from the FHWA, AASHTO, and/or the Transportation Research Board (TRB), the scan team intends to organize webinars during the 2016 calendar year to promote the findings and recommendations from the scan. It is expected that the three Category 1 states will present, along with a technical panel member, who will share the scan's findings.

- **Present findings at technical meetings and conferences**
  This scan's results can be presented at a number of upcoming technical meetings and conferences. Individual scan team members will be assigned responsibility for presenting the scan's results at the TRB Annual Meeting[50], various AASHTO meetings, regional maintenance meetings, and the 2016 National Transportation Asset Management Conference[51] hosted by TRB.

- **Conduct a technology showcase**
  There were several examples of Category 1 and 2 states using technology to support performance-based management of maintenance activities. At upcoming technical meetings and conferences, most notably AASHTO's Subcommittee on Maintenance meetings Category 1 and 2 state representatives could showcase the technology they use and how this technology supports their maintenance programs.

48 AASHTO Subcommittee on Maintenance, American Association of State Highway and Transportation Officials, http://maintenance.transportation.org/Pages/default.aspx

49 AASHTO TAM Portal, American Association of State Highway and Transportation Officials, http://www.tam-portal.com/

50 Transportation Research Board 96th Annual Meeting, Transportation Research Board, The National Academies of Sciences, Engineering, and Medicine, http://www.trb.org/AnnualMeeting/AnnualMeeting.aspx

51 11th National Conference on Transportation Asset Management, Transportation Research Board, The National Academies of Sciences, Engineering, and Medicine, http://www.trb.org/Calendar/Blurbs/171403.aspx

Activities That Advance the State of the Practice

One of the most important ways to advance the recommendations from the scan is to promote the research and technology transfer initiatives through AASHTO and the FHWA. Therefore, scan team members will be assigned to work with various AASHTO committees and subcommittees. These efforts will help build support for the recommendations with AASHTO leadership and promote research needs with AASHTO's Standing Committee on Highways[52] and Standing Committee on Research[53].

- **Develop plans for a peer exchange**
  Through funding support from the NCHRP U.S. Domestic Scan Program[54], the scan team intends to conduct a peer exchange that promotes the sharing of performance-based management practices, policies, and tools. In addition to sharing the scan's results, peer exchange participants will be able to discuss how other agencies are using technology, involving stakeholders, and building a culture to support performance-based management. The peer exchange might be conducted in conjunction with a technical meeting or conference, or it might be scheduled independently.

- **Develop a clearinghouse**
  In the past, a hosted website has shared information on state MQA programs. Over the years, that information has become outdated; the website is no longer maintained. The scan team is investigating the feasibility of developing an online clearinghouse that serves as a resource for identifying personnel at Category 1 and 2 agencies who could serve as a support network for agencies looking to develop performance-based management programs and strategies to support funding decisions. The clearinghouse would also include links to research reports and other documents dealing with this topic, including job descriptions for positions such as legislative liaisons and regional business analysts.

- **Develop communication tools**
  Part of the scan effort included developing a PowerPoint presentation to be used by technical panel members when they present the scan's findings at conferences and meetings. This will ensure that the information shared with audiences is consistent and reliable.

  The scan team proposes that other communication tools be developed for use by agencies that want to promote the scan's findings and relate them to proposed changes within their own agency. Examples of the types of communication tools that could be developed would be a legislator's guide to maintenance or a guide on data collection and quality assurance. Each of these tools would be designed and developed for a specific target audience and would share key information about maintenance that is most relevant to the target audience. These tools will be explored further with the AASHTO SCOM to identify funding sources. Three websites (i.e., AASHTO's Subcommittee on Maintenance, FHWA's Office of Asset Management[55], and AASHTO's Transportation Asset Management Portal) were identified as potential distribution mechanisms for any products that result from this effort.

52 AASHTO Standing Committee on Highways, American Association of State Highway and Transportation Officials, http://highways.transportation.org/Pages/default.aspx

53 AASHTO Standing Committee on Research/Research Advisory Committee, American Association of State Highway and Transportation Officials,http://research.transportation.org/Pages/default.aspx

54 NCHRP 20-68A, US Domestic Scan Program, Transportation Research Board, The National Academies of Sciences, Engineering, and Medicine, http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=1570

55 Asset Management, Federal Highway Administration, U.S. Department of Transportation, http://www.fhwa.dot.gov/asset/

- **Develop national guidance on data quality, governance, and utilization**
  One of the project recommendations involves the development of national guidance on data quality, governance, and utilization to help maintenance organizations overcome the data hurdles they face as they adopt the practices exhibited by the Category 1 state DOTs. The scan team will develop a research needs statement for consideration by the AASHTO SCOM for funding through NCHRP.

- **Develop parameters for an external process review of maintenance activities**
  At least one of the Category 1 states featured in the scan benefitted from an outside review of its maintenance practices that led to additional funding to support the added maintenance needs associated with capital expansion projects. The outside review differed from a traditional audit that typically focuses more on procedural use of funds to ensure that all rules and regulations have been followed. The scan team will discuss this topic further during one of its conference calls to determine whether this initiative will be done by the scan team members using information provided by the states or whether a research needs statement should be developed to secure NCHRP funding.

Appendix A
Scan Team Biographical Sketches

MARK C. McCONNELL (AASHTO CHAIR) currently serves as the deputy executive director and chief engineer for Mississippi DOT in Jackson. Appointed to this position in 2012, he manages pre-construction, construction, maintenance, and operations for the state's highway and bridge system. He oversees six engineering districts; three assistant chief engineers for Operations, Field Operations and Pre-construction; and the Divisions of Programming, Transportation Information, and Consulting Services. McConnell has been a part of the MDOT team for 28 years, coming up through the ranks in construction, maintenance and administration. A large part of his time has been in maintenance and operations either in the field or in the central office. He currently serves as the chairman of the American Association of State Highway Transportation Officials (AASHTO) Subcommittee on Maintenance, chairman of AASHTO's US Route Numbering Committee, chairman of AASHTO's TSP2 Oversight Committee, and a member of the AASHTO Standing Committee on Highways. He is a registered professional engineer in Mississippi and a member of the Mississippi Engineering Society. McConnell received his bachelor's degree in civil engineering from Louisiana State University in Baton Rouge.

DALE DOUGHTY is the Director of the Bureau of Maintenance and Operations at MaineDOT. The Bureau of Maintenance and Operations has a budget of approximately $160M annually and consists of approximately 1450 full time equivalent positions and numerous contracting partners. The Bureau is responsible for operating and maintaining all State owned transportation assets, which include approximately 8800 miles of highway, 2750 bridges, 7 ferries serving 6 island communities, 550 miles of railroad right of way, and various other assets. Doughty is a 1986 graduate of the University of Maine at Farmington in Geology and Chemistry and did additional graduate work at West Virginia University in geology. Doughty has been at MaineDOT for almost 19 years, previously working at as hydrogeologist, planner and regional manager. Prior to coming to MaineDOT he worked as an engineering geologist with two consulting firms based in Maine. Doughty has been licensed as a Maine Certified Geologist since 1996.

TIM LATTNER is currently the director of the Office of Design at Florida DOT, which reports to the chief engineer. This position's mission is to lead, guide, and support the Florida design community to deliver innovative transportation solutions for the effective delivery of the Florida DOT's Work Program. The Office of Design consists of over 140 people in five offices dedicated to that effort, including Roadway Design, Structures Design, Production Support, CADD, and Surveying & Mapping and provides policies, procedures, manuals, computer applications, quality assurance, management tools, training, and other production support to seven districts and Florida's Turnpike Enterprise. Lattner also serves as Florida DOT's liaison with the state's Association of County Engineers and Road Superintendents. Lattner graduated from the University of Central Florida with a bachelor's degree in civil engineering; he is a registered professional engineer in Florida. He served as the director for the Office of Maintenance at the Florida DOT, where he was responsible for policy, procedures, and budget to ensure that all state roadways and bridges are maintained at or above Florida DOT standards, that all state and local bridges are inspected as required, that interstate weight stations are open and operating, and that overweight/over-dimension permits are issued in a safe and timely manner.

LAURA J. MESTER is the chief administrative officer for Michigan DOT. In this role, she oversees the Bureaus of Finance and Administration; Transportation Planning; the Aeronautics, Passenger Transportation, and Rail Offices; and Sault Ste. Marie International Bridge operations. Mester serves as vice chair of the AASHTO Subcommittee on Transportation Finance Policy and is a member of the Subcommittee on Finance and Administration. She is also a member of the FHWA's Transportation Asset Management Expert Task Group. She received a bachelor's degree in accounting from Michigan State University and a master's degree in business administration from Central Michigan University. She is a registered certified public accountant in Michigan.

CORY POPE was, at the time of the scan, the director of Program Development for Utah DOT; he has since retired. His direct responsibilities at Utah DOT included statewide long-range planning, asset management, and programming for the Statewide Transportation Implementation Plan. Pope has been an active participant at AASHTO, where he served as a Utah DOT representative for the Standing Committee on Planning, the Subcommittee on Asset Management, and the Standing Committee on Performance Management. Pope's career at UDOT spanned 28 years, with over 10 years in the construction area and six in northern Utah as a regional director. He is a graduate of the University of Utah, where he earned a bachelor's degree in civil engineering. He is a registered professional engineer.

TONY SULLIVAN is the assistant chief engineer, Operations, Arkansas HTD. In this role, he oversees the Operations branch of the department, which includes the Construction, Maintenance, and Materials Divisions and the 10 district offices throughout the state. He previously served as traffic engineer, assistant state maintenance engineer, and state maintenance engineer with the department. He has served on several AASHTO subcommittees, including Traffic Engineering, Transportation Systems Management and Operations, Construction, Materials, and Maintenance. He received a bachelor's degree in civil engineering from the University of Arkansas and is a licensed professional engineer.

THOMAS VAN is a civil engineer in FHWA's Office of Asset Management. In this position, he serves as the lead specialist on asset management and performance management issues related to highway pavements. Van is one of the primary developers of the federal rules implementing the MAP-21 and FAST Act legislation. He has served in positions in the field of pavements and materials within FHWA in New Jersey and Washington, DC, for over 20 years. Van received a master's degree in civil engineering from Virginia Tech and is a licensed professional engineer.

LONNIE WATKINS is with the North Carolina DOT. He is the State Management Systems engineer and is the unit head for the Management Systems and Assessments Unit, overseeing its maintenance condition assessment program, asset management system, road inventory and mapping section. He has been with NCDOT for over 22 years. Watkins graduated from North Carolina State University, where he received a bachelor's degree in civil engineering.

KATIE ZIMMERMAN PE (SUBJECT MATTER EXPERT) is the president and founder of Applied Pavement Technology, Inc. (APTech). She is actively involved in the asset management community, working with transportation agencies to develop asset management plans and to better use asset data to improve planning, programming, budgeting, and investment decisions. Her work has included the development of guidelines on the use of Maintenance Quality Assurance (MQA) programs. She recently completed a synthesis on field inspection practices used to support MQA activities. In 2011, Zimmerman served as the subject matter expert for a domestic scan titled *Best Practices in Performance Measuring for Highway Maintenance Preservation*. She currently chairs the Transportation Research Board's Committee on Transportation Asset Management. She received both bachelor's and master's degrees in civil engineering from the University of Illinois.

Appendix B
Scan Team Contact Information

Mark C. McConnell PE – AASHTO Chair
Deputy Executive Director/Chief Engineer
Mississippi Department of Transportation
PO Box 1850
Jackson, MS 39215-1850
Phone: (601) 359-7004
Fax: (601) 359-7050
E-mail: mmcconnell@mdot.state.ms.us

Dale Doughty
Director of the Bureau of Maintenance and Operations
Maine Department of Transportation
16 State House Station, Transportation Building,
Augusta, ME 04333
Phone: (207) 624-3600
Email: dale.doughty@maine.gov

Tim Lattner PE
Director, Office of Design
Florida Department of Transportation
605 Suwannee Street - MS-38
Tallahassee, FL 32399-0450
Phone: (850) 414-4175
Fax: (850) 414-4791
E-mail: tim.lattner@dot.state.fl.us

Laura J. Mester CPA
Chief Administrative Officer
Michigan Department of Transportation
State Transportation Building
425 W. Ottawa Street
PO Box 30050
Lansing, MI 48909
Phone: (517) 241-2674
E-mail: mesterl@michigan.gov

Cory Pope PE
Program Development Director
Utah Department of Transportation
PO Box 143600
Salt Lake City, UT 84114-3600
Phone: (801) 965-4082
Fax: (801) 965-4551
E-mail: corypope@utah.gov

Tony Sullivan
Assistant Chief Engineer – Operations
Arkansas State Highway & Transportation Department (AHTD)
PO Box 2261
10324 Interstate 30, State Highway Building
Little Rock, AR 72203
Phone: (501) 569-2221
Fax: (501) 569-2688
E-mail: tony.sullivan@ahtd.ar.gov

Thomas Van
Office of Asset Management, Pavements, and Construction, Asset Management Team
(HIF-HIAP-40 / Room E73-458)
FHWA
1200 New Jersey Avenue, SE
Washington, DC 20590-9898
Phone: (202) 366-1341
E-mail: thomas.van@dot.gov

Lonnie Watkins
State Management Systems Engineer
Management Systems and Assessments Unit
North Carolina Department of Transportation
4809 Beryl Road
Raleigh, NC 27606
Phone: (919) 835-8421
E-mail: lrwatkins@ncdot.gov

Katie Zimmerman PE – Subject Matter Expert
President
Applied Pavement Technology, Inc.
115 W. Main, Suite 400
Urbana, IL 61801
Phone: (217) 398-3977
Fax: (217) 398-4027
E-mail: kzimmerman@appliedpavement.com

Appendix C: Amplifying Questions

Amplifying Questions

The following amplifying questions were sent to each of the participating agencies prior to the scan to capture background information.

A. General Agency Information to be Prepared by All Agencies (Please provide this information PRIOR to the start of the domestic scan. It will be compiled into a book that is distributed to participants in advance.)

1. Please provide a brief overview of your organization, including the following:
   a. The number of total miles in your network.
   b. The agency size and organization.
   c. The type of decision process that exists for maintenance and preservation activities (e.g., centralized, decentralized, or mixed).
   d. The typical cycle for making resource allocation decisions (e.g., annual, every two years).
   e. A completed copy of the following table (or a modified table that better suits your situation). You can skip any activities that your agency does not use.

Activity Type	Funding Classification (Maintenance, Preservation, or Capital)	Percent of Activity Conducted by InHouse Personnel	Percent of Activity Conducted Under Contract
Plan Mix Patching (Manual)			
Plant Mix Patching (Mechanical)			
Base Repair			
Pressure Grouting			
Concrete Pavement Joint Repair			
Concrete Slope Pavement Joint Repair			
Concrete Pavement Surface Repair			
Motor Grader Operation			
Repair Slopes, Ditches			
Sodding			
Seeding, Fertilizing, and Mulching			
Reworking Shoulders			
Clean Drainage Structures			
Repair or Replace Storm Drain, Side Drain, X-Drain			
Concrete Repair			
Concrete Sidewalk Repair			
Roadside Ditches – Clean and Reshape			

Activity Type	Funding Classification (Maintenance, Preservation, or Capital)	Percent of Activity Conducted by InHouse Personnel	Percent of Activity Conducted Under Contract
Large Machine Mowing			
Slope Mowing			
Intermediate Machine Mowing			
Small Machine Mowing			
Weed Control			
Wildflowers			
Fertilizing – Bulk			
Tree Trimming and Removal			
Landscape Area Maintenance			
Delineators			
Signs (ground signs 30 sf or less)			
Signs (ground signs over 30 ft and all overhead)			
Sign Cleaning			
Signal Maintenance			
Guardrail Repair			
Fence Repair			
Attenuator Inspection and Service			
Attenuator Repair			
Pavement Striping			
Raised Pavement Marker Replacement			
Graffiti Removal			
Roadside Litter Removal			
Road Sweeping			
Rest Area Maintenance			
Bridge Joint Repair			
Bridge Deck Maintenance and Repair			
Bridge Handrail Maintenance and Repair			
Superstructure Maintenance and Repair			
Substructure Maintenance and Repair			
Channel Maintenance			
Routine Bridge Electrical Maintenance			
Routine Bridge Mechanical Maintenance			
Movable Bridge Structural Maintenance			
Fleet Operations and Maintenance			

Activity Type	Funding Classification (Maintenance, Preservation, or Capital)	Percent of Activity Conducted by InHouse Personnel	Percent of Activity Conducted Under Contract
Mill and Resurfacing			
Thin Overlays			
Chip Seals			
Winter Snow and Ice Removal			

B. Scan-Specific Information to Be Discussed and Presented During the Scan – All Agencies Should Be Prepared to Address These Questions During the Scan

Please provide the following information about your Maintenance Quality Assurance (MQA) program.

1. **Description of the MQA Program and MMS Software (Purpose and History)**
    a. What MMS tools are you using? Are there difference tools used at the statewide and region/district levels for maintenance budgeting activities?
    b. Please describe your level of confidence in the following using terms such as High, Moderate, or Low:
        i. The asset inventory
        ii. The asset condition information
        iii. The unit cost data
        iv. The ability of the system to project maintenance needs
    c. If you described your level of confidence in the previous question as "High" for any of the items, please describe the factors that have contributed to your success. If you rated any of the items as "Low," please identify the barriers that have to be overcome.
    d. How well does your MQA program meet your needs from a budgeting perspective? What keeps you from using the results more?
    e. How integrated is your MMS with other programs, such as the pavement and bridge management system? Is this level of integration reasonable?
    f. To what degree can you forecast changes in maintenance needs over time? Explain your answer.
    g. What additional tools do you need?
    h. What changes would you make to your program if you could?
    i. How do you communicate needs for activities that don't address the condition of an asset, such as snow removal or contract administration?
2. **MQA Measures**
    a. Is your rating system a pass/fail (P/F) method or a level of service (LOS) approach?
    b. Do you have an overall maintenance rating? If so, how is it determined?

c. How does your agency establish maintenance performance targets? Are the targets realistic for anticipated funding levels? If not, are you changing your targets?

d. How are performance measures used to hold personnel accountable?

e. What measures are reported to executives and external stakeholders?

f. How do maintenance performance measures relate to other agency measures?

3. **Allocating Funding to Regions/Districts**

a. How are funds allocated at the region/district level? What factors are used to consider region allocations (such as level of service, mileage, traffic volume, and so on)? Do you allocate funds differently by system (functional class) and/or by traffic volume?

b. What percentage of the needs is funded? How are need levels at the region/district level established?

c. What is the process for allocating maintenance and preservation funds to different types of assets, such as bridges, pavements, drainage systems, and so on? How do you establish maintenance priorities within each pot of money? To what degree are these allocations based on performance data?

d. If funding is not adequate to meet targets, how do you decide what gets funded? How closely do region/district priorities tie to statewide strategic priorities?

e. Are regions/districts required to submit plans showing how funds will be used? How are these plans developed? How much flexibility do the regions/districts have in developing the plan? To what degree is performance data used at this level to develop their plans? For instance, are they given a performance target to achieve with the funding?

f. How strongly can you link maintenance accomplishments with differences in the resulting level of service? What level of confidence do you have in your results?

g. Who is involved in the process and what are the roles and responsibilities?

h. What kinds of constraints does the DOT face in allocating maintenance and preservation resources?

i. How are ancillary assets and ADA requirements incorporated into project costs at the budgeting level?

j. How are region/district personnel held accountable for using funds wisely? What is the review process that is used to evaluate performance?

k. What have been your successes and challenges in this area?

C. Scan-Specific Information to Be Discussed and Presented During the Scan – Only Florida, Utah, and Washington DOTs Need to Respond to These Questions

The three host states were selected due to their use of performance-based budgeting to establish maintenance funding levels at the highest levels of the organization. The scan team is very interested in learning more about how you were able to achieve this level of participation in the funding allocation process and the strategies that have enabled you to compete for additional funding to address maintenance needs. The following questions are provided to explore these topics further.

1. **Establishing Maintenance Funding Levels**

   a. Please provide an overview of how maintenance funding levels are determined and allocated to the DOT.

   b. What factors most contributed to your ability to compete for maintenance funding? How have you been able to sustain this level of involvement?

   c. What funding "pots" are allocated for maintenance and preservation activities? Are there dedicated funds (e.g., a trust fund) for maintenance and preservation activities? Is the DOT competing for revenue with other state agencies?

   d. How does your agency evaluate tradeoffs between maintenance, preservation, and capital expansion projects? Are you able to forecast future maintenance needs with confidence? `

   e. How do you establish maintenance performance targets at the statewide level? If funding is not adequate to meet performance targets, how do you decide what gets funded?

   f. How strongly are you maintenance performance targets linked to your agency's statewide strategic priorities?

   g. Who is involved in this process and what are the roles and responsibilities?

   h. To what degree does performance data influence maintenance budget allocations? Are there legislative initiatives and mandates that impact funding levels and priorities?

   i. To what degree does GASB 34 influence maintenance budget allocations?

   j. How do snow and ice removal and/or emergency operations impact budgeting activities?

   k. What have been your successes and challenges in this area?

2. **Sustainable Funding Levels**

   a. To what degree do you feel your maintenance funding is adequate to meet future needs? How do you know?

   b. What examples can you provide illustrating how you have been able to generate additional funding to support maintenance and preservation needs? Can you show that the increased funding led to improvement in the Level of Service provided?

   c. What strategies have been most successful at conveying maintenance needs in a persuasive manner?

   d. What roadblocks have you had to overcome to enable your agency to obtain adequate levels of maintenance and preservation funding?

   e. What advice would you provide to other states interested in being able to successfully compete for additional maintenance funding?

   f. How has the agency culture supported the philosophy that is used to establish and allocate maintenance funding levels? How have you been able to institutionalize this philosophy in your state?

   g. To what degree is maintenance represented in your Transportation Asset Management Plan (TAMP) as required under MAP-21?

Appendix D:
Host Agency Contacts

Arizona

Justin Crowder
Maintenance Management Administrator
Arizona Department of Transportation
Phone: (602) 712-3830
E-mail: jcrowder@azdot.gov

Troy Keener
Resource Manager
Arizona Department of Transportation
Phone: (602) 712-7403
E-mail: tkeener@azdot.gov

Colorado

Kyle Lester
Director, Division of Maintenance
Colorado Department of Transportation
Phone: (303) 512-5218
E-mail: kyle.lester@state.co.us

Mike Goolsby
Region 3 Maintenance Superintendent
Colorado Department of Transportation
Phone: (970) 683-6305
E-mail: michael.goolsby@state.co.us

B.J. McElroy
MLOS System Manager
Colorado Department of Transportation
Phone: (303) 512-5508
E-mail: braporh.mcelroy@state.co.us

Florida

Rudy Powell
Director, Office of Maintenance
Florida Department of Transportation
Phone: (866) 374-3368, Ext. 5757
E-mail: rudy.powell@dot.state.fl.us

Kristin McCrary
Roadway Maintenance/MRP
Florida Department of Transportation
Phone: (850) 410-5694
E-mail: kristin.mccrary@dot.state.fl.us

Tim Allen
Roadway Maintenance/MRP
Florida Department of Transportation
Phone: (850) 410-5757
E-mail: tim.allen@dot.state.fl.us

Kirk Hutchinson
Performance Management Manager
Florida Department of Transportation
Phone: (850) 410-5515
E-mail: kirk.hutchinson@dot.state.fl.us

Michael J. Soto
Program Resource Administrator
Florida Department of Transportation
Phone: (850) 410-5725
E-mail: michael.soto@dot.state.fl.us

Mississippi

Heath T. Patterson PE
State Maintenance Engineer
Mississippi Department of Transportation
Phone: (601) 359-7113
E-mail: hpatterson@mdot.ms.gov

North Carolina

Matthew Whitley
Maintenance Management Engineer
North Carolina Department of Transportation
Phone: (919) 835-8446
E-mail: mpwhitley@ncdot.gov

Delbert Roddenberry
Secondary Roads Program Manager
North Carolina Department of Transportation
Phone: (919) 707-2509
E-mail: droddenbertty@ncdot.gov

Tennessee

Chuck Rychen PE
Assistant Chief Engineer of Operations
Tennessee Department of Transportation
Phone: (615) 741-2342
E-mail: charles.rychen@tn.gov

Jerry Hatcher PE
Maintenance Division Director
Tennessee Department of Transportation
Phone: (615) 741-2027

E-mail: jerry.hatcher@tn.gov

Chris Harris PE
Civil Engineering Manager 1
Tennessee Department of Transportation
Phone: (615) 532-3453
E-mail: chris.harris@tn.gov

Jim Maxwell PE
Civil Engineering Manager 2
Tennessee Department of Transportation
Phone: (615) 253-0012
E-mail: james.Maxwell@tn.gov

Matt Chandler PE
Transportation Project Specialist – Senior
Tennessee Department of Transportation
Phone: (615) 532-3621
E-mail: matthew.chandler@tn.gov

Bret Dennis EIT
Transportation Project Specialist
Tennessee Department of Transportation
Phone: (615) 253-5457
E-mail: bret.dennis@tn.gov

Utah

Kevin Griffin PE
Director of Maintenance
Utah Department of Transportation
Phone: (801) 985-4120

E-mail: kgriffin@utah.gov

Virginia (via web meeting)

Jennifer Ahlin
Division Administrator for Operations Planning
Virginia Department of Transportation
Phone: (804) 786-8157
E-mail: jennifer.ahlin@vdot.virginia.gov

Robert E. Prezioso
State Infrastructure Manager
Virginia Department of Transportation
Phone: (804) 786-0816
E-mail: robert.prezioso@vdot.virginia.gov

Washington

Pasco Bakotich III PE
Director of Maintenance Operations
Washington State Department of Transportation
Phone: (360) 705-7231
E-mail: bakotiP@wsdot.wa.gov

Greg Selstead
Assistant State Maintenance Engineer
Washington State Department of Transportation
Phone: (360) 280-0917
E-mail: selsteg@wsdot.wa.gov

Rico Baroga
Maintenance Policy Manager
Washington State Department of Transportation
Phone: (360) 705-7864

E-mail: barogar@wsdot.wa.gov

Debbie Carpenter
Executive Assistant for Pasco Bakotisch
Washington State Department of Transportation
Phone: (360) 705-7859
E-mail: carpend@wsdot.wa.gov

Wisconsin

Scott Bush
Compass Program Manager
Wisconsin Department of Transportation
Phone: (608) 266-8666
E-mail: scott.bush@dot.wi.gov


NORTH
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