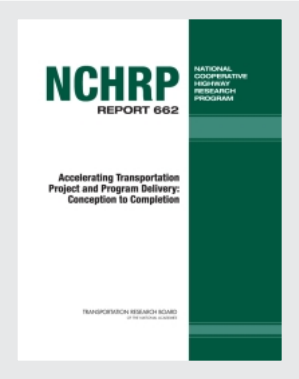

Accelerating Transportation Project and Program Delivery: Conception to Completion

DETAILS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP REPORT 662

Accelerating Transportation Project and Program Delivery: Conception to Completion

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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

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

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

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

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

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FOREWORD

By Andrew C. Lemer
Staff Officer
Transportation Research Board

NCHRP Report 662 describes how selected transportation agencies have reduced the time required to complete the project delivery process. This process takes new or renewed transportation facilities and services from conception to completion, ready for users. Project delivery is a primary indicator of an agency's effectiveness. Individual highway and other transportation projects are developed under programs intended to implement agency and legislative initiatives and other public policy. The way programs are organized and managed can determine the speed and efficiency of project development. Accelerating program functions can speed up project delivery. This report describes the experiences of eight state departments of transportation (DOTs) that made improvements in their project delivery and the lessons to be learned from their experiences. The information will be useful to DOT managers seeking to ensure that their agencies' organization, policies, and program operations facilitate project delivery.

Transportation agencies seek continually to improve their managerial, organizational, and operational effectiveness and project delivery—the process that takes new or renewed transportation facilities and services from conception to completion—is a primary indicator of an agency's performance. Individual highway and other transportation projects are developed under programs intended to implement agency and legislative initiatives and other public policy. The way programs are organized and managed influence the speed and efficiency of project development. Improving efficiency in program functions can speed up project delivery.

The delivery process includes planning, programming, design, construction, and related activities. Accelerating delivery entails addressing environmental review issues in a timely manner, acquiring rights-of-way from multiple property owners, developing context-sensitive solutions in design, securing approvals from myriad government agencies, understanding and addressing various community concerns, assuring that project development resources are available when needed, and identifying and reducing impediments to decision making. It is not unusual for major projects to take five to seven years in the development phases and then three to four years more in construction; projects take far longer when significant community, environmental, or property acquisition issues must be resolved. Slow project delivery increases congestion and project expenses, adversely affects safety, imposes social costs, and impedes economic development.

Much research on accelerating delivery has focused on tools and business practices that can speed the completion of particular phases of the project delivery process. Few studies have addressed the subject of acceleration from a holistic perspective, looking at the agency and program context and full delivery process from initial conception to completion of con-

struction. Most agencies have been organized to manage the sequential phases of project delivery individually, without consideration of the overall process. Project development for these agencies entails a series of formal hand-offs between organizational units, with each unit responsible only for its own phase.

Delays that arise, however, often are a result of factors that influence several project delivery phases, such as an agency's internal management procedures, legal requirements, and funding uncertainties. In addition, delays are an outgrowth of the way programs are structured and administered. Making changes to expedite completion of each individual phase may improve project delivery, but opportunities to make improvements through better organization and management of the delivery process overall are lost.

This report is the product of NCHRP Project 20-73, intended to describe these opportunities to improve the overall delivery process and how DOTs and other agencies may take advantage of them. The research provides examples and guidance regarding best practices for accelerating program and project delivery while maintaining quality.

A team led by Jacobs Engineering Group Inc., Morristown, NJ, conducted this research. While the project entailed a comprehensive literature review and generic assessment of factors contributing to delays in project delivery, an in-depth review of how eight DOTs achieved noteworthy improvements in their project delivery performance is the core of the work. The research team reviewed agency documents and conducted interviews with key personnel in each agency. The case studies reveal common themes, including factors contributing to success; impediments, advantages, and disadvantages of acceleration strategies, techniques, and practices; and organizational and process issues affecting delivery.

CONTENTS

SUMMARY

Accelerating Transportation Project and Program Delivery: Conception to Completion

The demand for continued infrastructure investments in today's environment places increased pressure on transportation professionals to expedite the delivery of projects and programs. Along with reduced delivery schedules, projects must also maintain high quality while minimizing cost. Environmental issues, community activists, stricter regulations, and variable risks are among the myriad of factors that impact project delivery. The transportation industry is transforming itself as new ways of delivering projects compete with established ones.

Recent advancements have been made in improving project delivery by accelerating critical phases of a project; however, the literature is lacking in documentation of program and project acceleration through innovative holistic methods. This lack has prompted the need to research best practices that provide transportation decision makers at the state level with some options for accelerating their programs and projects holistically.

Eight states were selected for this research: California, Maine, Maryland, Missouri, New Jersey, North Carolina, Utah, and Texas. Their best practices are documented in the case studies included in this report. Among the research findings was a pattern of shifts in the way departments of transportation (DOTs) do business. While the technical aspects of developing a project or program can be considered a constant among all of the agencies, the DOTs of today have a different focus and adhere to a different set of rules.

Trends

In the course of studying these states, it became evident that certain trends and challenges were common to many of them. The identified trends are discussed briefly in the following paragraphs:

Research indicates that state DOTs are increasingly identifying performance measures as one of their most pressing needs. As attainable goals and targets are set and achieved, programs and projects are accelerated. While the traditional project approach placed greater emphases in the design phase, current approaches focus on thoroughly outlining the purpose and need, carefully defining the scope to considerable detail, and clearly outlining the front end of a project even before the feasibility assessment stage.

More state DOTs are beginning to use Project Management Institute philosophies to deliver projects, balancing the quadruple constraints of a project (scope, schedule, budget, and quality), more and more in their management activities. Leadership was found to play a critical role in the efficiency with which programs are executed. Managers and administrators orchestrate the dynamic interplay that occurs between individuals, work teams, agencies, and stakeholders for an initiative to come to fruition. Strong leadership at the top sets the stage for performance at all other levels.

DOT employees are communicating laterally and vertically, collaborating to reach difficult decisions, and cooperating to meet agreed-upon goals. This effort has led to true partnering with agencies and the public and the creation of trust-based relationships. The successes of high-performance teams, specialized function teams, and self-directed work teams support the finding that a team approach fosters accelerated project delivery. State DOTs have recognized that a supportive team environment drives project performance.

The need to produce more or better services with limited resources and environmental constraints has compelled state DOTs to change their organizational structures, empowering employees to unleash their creative potential and arrive at innovative solutions. Creative realignment—shifting the organization's culture—has required strategic management of the changes required to adapt to new ways of doing things. Which organizational structure better lends itself to efficient program and project delivery? Research has shown that the hierarchical "silos" of the past are gradually being replaced with flatter organizational models that create opportunities for communication and exchange of knowledge across management lines. Regionalization has often resulted in delivery of better quality products and services. Particularly in large states, regionalization offers district offices the flexibility to operate independently or to draw on the support of a larger regional office when required.

Research has discovered state DOTs moving toward greater levels of transparency—accountability—internally and with the public as well. Linked closely with performance measures, transparency also provides opportunities to establish baselines and set targets.

Challenges

The trends discussed in the following paragraphs have come about in response to a myriad of challenges faced by state DOTs:

- "The Perfect Storm"—The demanding and difficult climate within which today's DOTs must operate, created by aging infrastructure, financial constraints, increased population and congestion demands, and environmental sensitivity.
- Outsourcing vs. In-house—Striking the right balance of DOT personnel and professional consultant services to meet workload demands, accelerate programs in the best way, and save costs.
- Right-of-Way/Utilities/Railroads—The initial planning and scoping of a project has become more important than ever to expedite perhaps the most difficult project phases to accelerate.
- Setting Baselines and Targets—Critical to developing performance measures and asset management protocols to ensure efficient and expeditious use of limited dollars.
- Context-Sensitive Solutions—An integral step, especially in urban areas with major community concerns. However this strategy may not benefit all projects; used in the wrong setting, it could actually prolong the project schedule.
- Policies—Constant review and revision of state and federal DOT and environmental policies is required to ensure timely project delivery without sacrificing quality or environmental stewardship.

Through applying the listed trends and working through challenges, state DOTs have adapted their strategies and operations to become dynamic, flexible structures where communication and sharing of knowledge aids them in meeting their mission.

Case Studies

The case studies in this report highlight some of the best practices that follow a project from the start until the ribbon cutting. State DOTs have spent years first developing or implementing such holistic programs and then refining and modifying elements and

facets within. These experiences have culminated into the comprehensive best practices described.

California's success with performance measures allows them 100 percent program delivery annually. Maine's comprehensive bridge tracking program, in concert with a team approach, has allowed the state to rehabilitate its bridges efficiently. Maryland's compendium of data and mission-centered performance measures establish a baseline of the health of its transportation system and set a clear target on future goals. Missouri measures tangible results within its unique organizational structure and has succeeded in becoming a transparent agency through the publication of the *Tracker.* New Jersey DOT's pipeline delivery process identifies the anticipated level of review and regulatory issues presented by a project, then adds it to the appropriate pipeline to minimize unnecessary delays. North Carolina's success stories revolve around the Merger 01 process, which brings the DOT, stakeholders, and permitting agencies to the table at strategic points of project development for consensus in decisions. The Texas DOT has effectively used innovative contracting methods for project delivery and financing, including evergreen contracts and comprehensive development agreements. Utah involves and engages both the designer and contractor during project development to facilitate design and resolve potential constructability issues early on. Its construction manager–general contractor procurement method has allowed the state to accelerate project delivery appreciably.

Amid the complexity and limitations of the current environment, state DOTs continue to provide the services that are expected of them to support the transportation infrastructure that the U.S. economy cannot be sustained without. This report provides a glimpse of how they deliver programs and projects from conception to completion.

CHAPTER 1

Introduction and Background

Introduction

Delivering high-quality transportation programs and projects on schedule and within budget is a goal shared by transportation departments and highway administrations across the United States. Each state presents a unique set of circumstances for its DOT to overcome in carrying out its mission. Aging infrastructure, limited funding, community concerns, and political influences are just some of the factors that hinder the expedient delivery of a program or project. Additionally, the changing demographic and economic trends of the American public pose another layer of difficulty for transportation professionals to expedite programs. With more individuals entering the workforce and relying on an already saturated network of roads and highways for their mobility needs, state officials have had to deal with the imbalance of higher demands and constrained outputs in surface transportation projects. In this environment, any tool or method shown to accelerate transportation program or project delivery at the state level warrants a closer look and a serious assessment of its potential to succeed in a different state.

In recent years, state DOTs have made advancements in improving project delivery by accelerating critical phases of a project, improving the communication among stakeholders, strengthening public outreach efforts, and expediting the permit approval processes by collaborating with environmental agencies. However, none of these efforts lend themselves to a holistic approach in program and project delivery. By their very nature, they are segmented and provide only brief accelerations in project delivery.

Several states have taken a broader approach to delivering programs and projects. Expanding on smaller successes, combining winning strategies, and taking a holistic approach to project delivery have all led to reduced time frames and, in some cases, cost savings in delivering projects. States are taking on more risks and trying innovative procedures to meet milestone dates and open facilities to the public as promised. These successes have been realized through processes that view the projects as one continuous, fluid endeavor from beginning to end.

This report examines the characteristics, methods, and practices employed by the DOTs of eight states, identified through a literature review and selected for their representative characteristics, to aid in accelerating their programs and projects. In addition, this report presents an analysis of the common trends—and the common challenges—that surfaced during the research. What becomes patently clear in studying each of the investigated states is that today's financial, social, environmental, and political climates are vastly different from what they were 50 years ago. This change, combined with an ever-increasing population and maturing infrastructure, demands that transportation agencies examine and adjust their goals, objectives, and methods on an ongoing basis to accomplish their mission and provide the public with an outstanding roadway network.

This report is intended to benefit individuals involved in the planning, implementation, and management of public transportation programs and projects at the state level, particularly in the area of highways and bridges. It is recommended that users of this report have the following basic skills and/or background:

- An understanding of project management principles for highway design, construction, and maintenance, within the context of a state DOT
- Familiarity with the federal funding process for transportation projects through approved transportation improvement plans developed by metropolitan planning organizations
- An understanding of federal and state environmental and other regulatory permitting and approval processes, right-of-way, and utilities
- A basic knowledge of contracting methods for procurement of professional, construction, and management services

Background

Transportation projects, which include highways, bridges, and railroads, have a large impact on the immediate economic and social environment. Their effects are felt over many years as they change the physical landscape and transform the quality of human life by allowing regions to become accessible. In general, large projects have such a multitude of interwoven components and stakeholders that completing them on schedule, on budget, and to acceptable standards becomes a complex challenge. Another challenge presents itself in maintaining these large capital investments over many years while strengthening relationships and coalitions with stakeholders and political leaders. Equally important are the smaller transportation projects which maintain, reconstruct, or expand existing facilities, or undertake emergency repairs. These projects compete for limited resources while customers demand higher-quality transportation options and cost-efficient solutions delivered in a timely manner with minimal disruption. Meeting the transportation goals in today's fast-paced, ever-changing landscape requires a holistic approach.

Typically, a project begins with an idea or a concept to meet an identified need, which then graduates to the planning phase. It is then programmed and moves through design to reach the final construction phase, sometimes many years later. The lengthy planning, design, and construction processes are often further slowed down by complex issues related to environment, community, property acquisitions, and funding. A goal of many transportation programs and projects in today's environment is for all aspects to be accelerated in one way or another so that benefits are realized in time and cost savings, without a sacrifice in the quality of the final product. Established acceleration techniques and strategies tend to address only one or two phases of the project at a time. Phases are segmented, and many acceleration tools and best practices apply only to a given phase. There are numerous impediments to developing a project with an approach that envisions the entire project, with all of its intricate issues, from conception to completion. One of the goals of this research is to uncover those processes by which state DOTs have made paradigm shifts toward accelerating projects holistically. In the course of obtaining information from eight DOTs from around the country, numerous methods leading to accelerated project delivery were identified and analyzed.

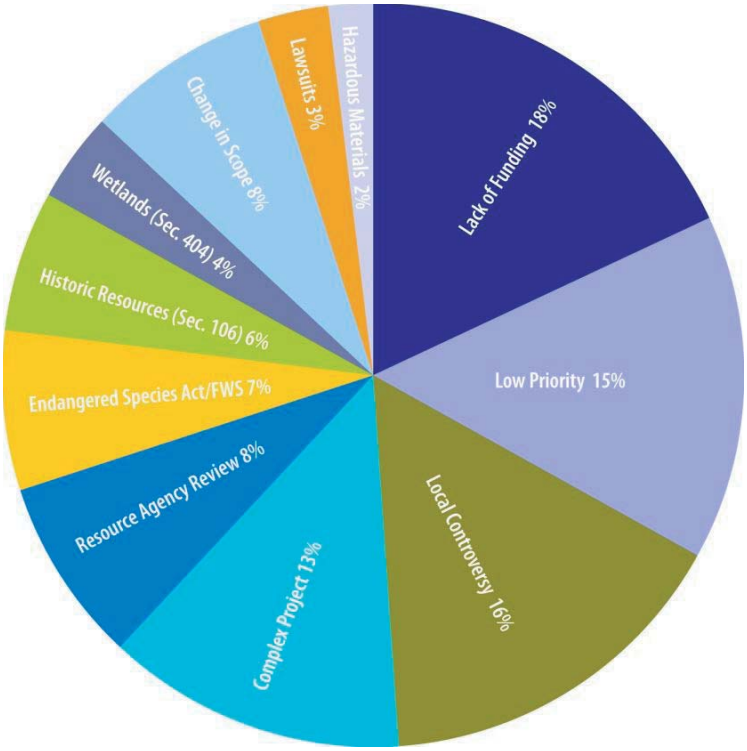
A considerable amount of published research on accelerating project delivery has focused on practices to speed completion of various phases of the project delivery process. However, few of these studies have taken a holistic approach to the entire delivery process from the first idea for a project to the opening for use by the public.

Most of the agencies implementing transportation programs and projects are organized by sequential work phases. This organization often creates hand-offs from one unit to another, in many cases leading to problems in project delivery stemming from changing managers, circumstances, resources, priorities, and influence. In addition, expediting transportation projects is also affected by an agency's organizational structure. Efficiency can be achieved via both process and organizational design. Often, overall strategic plans that foster an accelerated approach need to be implemented. These plans should hold their course throughout all phases of a project and be clearly supported throughout the organization.

Much has been done to increase the flexibility of funding and promote multimodal transportation, but there has been little change in the process of implementing projects since the road building era of the 1960s and the regulatory era of the 1970s. For example, in 2001, the average time required for major highways and airports to advance from planning to opening was 13 years and 10 years, respectively. Environmental permitting alone took more than three years (one-third of the planning time) to acquire. (*1*) In today's strained economic environment, where resources and funding are limited, it is unacceptable to delay transportation projects for so long by processes that perhaps could be shortened. Yet the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO) stated in a 2002 report that delays to project delivery were related to intrinsic flaws. Figure 1 indicates that unsuccessful delivery of a project was due to four predominant reasons: (a) lack of funding, (b) local controversy, (c) low priority, and (d) complexity of the project. (*2*)

NCHRP Project 20-24 compared state DOTs' construction project costs and schedule performance. The review of approximately 26,500 projects across 20 states revealed that in almost 50 percent of the cases, projects were not delivered on time. For projects over $5 million, 65 percent of the projects were not delivered on time. Other factors causing delays in project delivery are utility conflicts, right-of-way (ROW) acquisitions, environmental and political issues, and inadequate coordination between agencies and stakeholders. Many of these concerns can be addressed through programs that provide a holistic approach to program and project delivery.

The statistical trends are worth a second glance. America's population is expected to reach 420 million in the next 50 years. In the last 40 years, highway lane miles have increased by 6 percent while vehicle miles traveled (VMT) has increased by 194 percent. While business travel has kept pace with growth in employment, social and recreational travel has doubled in the last four decades. Because over 88 percent of workers commute in private vehicles, commuter traffic heavily impacts U.S. highways. The nation's interconnected transportation network moves about 12 billion ton-miles per day. All of these trends continue to have a direct impact on the transportation network. (*1*)



Source: FHWA, Reasons for Project Delays, 2002

Figure 1. Reasons for project delay.

To date, what is absent from the literature research is documentation of any holistic programs and projects that demonstrate how programs and projects are managed and accelerated from conception to completion. This absence in itself substantiates the need to research best practices that can provide state decision makers with some options for accelerating their programs and projects.

Scope of Study

Research began in July 2007 with a literature search, using key search words, to review serial publications, professional journals, articles, and databases to identify primary strategies and practices for accelerating programs and project delivery. Approximately 200 annotated references were generated from this search. These were reviewed to identify those strategies, best practices and methodologies currently being used to accelerate programs and projects across the United States.

In reviewing the literature, the research team noted that some states contributed more frequently to the body of published information on this topic. In addition, certain acceleration strategies were better documented than others. The research team maintained its focus on techniques and best practices that provided a holistic approach on project acceleration from conception to completion.

The results of the literature search were reviewed to narrow the list of states selected for further consideration. Case studies for final selection had to represent a range in size and scope of programs and projects, activities in rural and urban areas, and activities in large and small transportation agencies. The difficulty arising from this task was due to the large number of states that exhibited projects and programs that led to expedited project delivery. Many examples were cited in which some aspect of the project was accelerated so that the end result was a project completed on a shorter schedule. Other reviewed articles and reports highlighted large, complex projects that are not the typical project for implementation. Owing to their larger budgets and political support, such projects often got priority both within agencies and externally as well.

Apart from selecting such case studies, the team also had to research states that delivered basic operations and maintenance ("meat and potatoes") types of projects. These ongoing programs ensure infrastructure is in a state of good repair and systems are operating as effectively as possible. Narrowing down the long list of exceptionally well-documented examples of successful projects and programs was challenging. The team relied on selection criteria and panel comments to assist with the final list of states that resulted.

The preparation for interviewing the selected eight states required a flexible approach. In addition to individual inter-

views, the team felt that discussion panels or a workshop type of environment would help draw information from participants, as a group setting would elicit more discussion. By involving key staff members from different divisions and various backgrounds, the discussion format allowed participants to hear different perspectives of an issue.

Minutes were recorded by the research team at interviews and panel discussions carried out at each of the eight state DOT headquarters. Follow-up emails and conversations continued for clarification of discussion details. Then began the intensive task of developing case studies for each of the interviewed states. The research team continued with an analysis of the research findings and identified key points to focus on for each state DOT. Transcriptions of interviews, meeting minutes, printed materials, and online sources, including the state DOT websites, served as source material for the case studies.

Data Collection Approach

The literature review for this project followed a multistep approach. First, the team reviewed the relevant TRB references and the "Scoping Study for an AASHTO Guide on Accelerating Project Delivery" to identify preliminary references, search terms, and appropriate search engines. The identified terms mirrored those in the proposal:

- Project acceleration
- Project management
- Improving transportation project delivery/project delivery time factors/project delivery delays
- Environmental streamlining
- Bracketing planning and environmental analysis
- Engineering quality survey mapping
- Constructability reviews
- Milestone reviews
- Substantial completion reviews
- Proactive ROW acquisition
- A + B contracting
- Incentive payments/disincentive penalties
- Lane rental
- No excuse completion dates
- Innovative construction techniques

Second, the team conducted a general Internet search for relevant resources and then progressed to a specific search using search engines available through Virginia Tech library subscriptions. Search engines included Google, Factiva, JSTOR, Science Direct, Mergent Online, Lexis/Nexis Academic, ProQuest, and Compendex.

Approximately 195 of the identified articles concerned some aspect of project acceleration. These articles were sorted into 10 categories:

- Construction
- Contracting
- Project development, process, design and funding
- Environment
- Monitoring
- Multiproject factors
- Personnel issues
- Political and public relations
- Strategic planning, organization and culture
- Teamwork

The research team then revisited the search and broadened it to include the following sources and search terms:

- Dissertation Abstracts Online—This database includes over two million records for dissertations and theses from the United States, Canada, Britain, and other European countries. Abstracts are available since 1980 for most dissertations and since 1988 for most theses. The database includes dissertations and theses dating back to 1861. No full text is available from this database.
- Networked Digital Library of Theses and Dissertations—The Networked Digital Library of Theses and Dissertations Union Catalog is intended to serve as a repository of rich graduate educational material contributed by a number of member institutions worldwide, with the hope that this project will increase the availability of student research for scholars. Most of the included theses and dissertations are available in full text online.
- WorldCat Dissertations and Theses—All dissertations, theses, and published material based on theses and dissertations cataloged by Online Computer Library Center (OCLC) member libraries.
- Organizational theory and structure-specific references. (These terms were included in the initial search. This search was meant to provide more theoretical references that might have been overlooked during the initial search.)
- Document management references.

CHAPTER 2

Literature Review

Overview

The literature search revealed many articles, theses, and dissertations, which provided the research team with a starting point of what information was already documented. While certain subject areas had extensive information about topics such as design–build, fast-track construction, project management, and environmental streamlining, other areas were not so well documented, such as the impact of organizational structures on project delivery, risk management and use, and application of performance measures. Other topics—such as build–operate–transfer (BOT) models/projects, Enterprise Resource Planning (ERP) systems, and constructability reviews—consistently revealed published articles that could provide insight to accelerating projects from a broader perspective.

The literature search was categorized into four broad areas that would facilitate the research efforts: (a) acceleration through improved delivery processes; (b) acceleration through improved program structures; (c) acceleration through internal and external relationships and partnerships; and (d) acceleration through organizational issues.

Acceleration through Improved Delivery Processes

The delivery of a project can be accelerated through various means. One of the most commonly known processes is the design–build delivery of projects. Certainly the design–build process has proven to accelerate the completion of projects much quicker than traditional methods. However, other undocumented methods may exist that relate to the expedited delivery of projects. Some of these methods may not be so popular or may require greater risk. It may be the case that such methods are only applied to a very specific part of the project and hence do not yield an appreciative decrease in schedule. Previous research also indicates that transportation projects often take on a very segmented approach going from planning to design to permit approvals by a multitude of various agencies prior to construction. The lack of a seamless continuity in a project burdens the overall process and raises the final cost of completing the project. An improved delivery process that addresses all the phases and constraints of a project is required to allow for quicker delivery of projects. Items in this section focus primarily on project-level how-to methods and innovations. They may include planning, engineering, administrative, program implementation, or other types of process details. Particular attention is given to project events and the application of techniques that intend to enhance the performance of various tasks to ultimately accelerate project delivery.

Acceleration through Improved Program Structures

Many DOTs across the United States are structured in functional units, areas of specialization (e.g., planning, engineering, construction, environmental, maintenance, accounting, community outreach) that provide services to internal units and external clients. Each unit also has its own internal processes that serve to "move things along" within the unit. Part of the concern is that these units function independently. If information is needed from another unit, requests are transmitted up to the unit head who then communicates it to the other unit head. Projects are slowed down because the priority of one group may not necessarily be the priority of another group. This independence limits the project's ability to move seamlessly from one phase to the next. Improved program structures may allow a project to advance quickly through the pipeline of planning, design, and construction. Re-engineering and reorganizing DOT operations and programs within a structure may be a step to reduce the amount of time preceding project delivery. Items in this section focus primarily on

program-level methods and innovations associated with integrating project processes to support broader organizational objectives. Visioning, management of material, fiscal and human resources, management of risks, training, simulation techniques, environmental factors, and regulatory priorities are examples of program areas where integration may accelerate project delivery.

Acceleration through Internal and External Relationships and Partnerships

One element of a project as it moves through the different phases is stakeholder involvement. Both internal and external stakeholders have some concern regarding the way a project progresses. These partnerships become key elements that can either hinder a project from advancing or stimulate a project to be accelerated. These relationships are also an important aspect of the funding arrangements for a project or program. Similarly, an influential stakeholder or agency could effectively champion the project from beginning to end. Programmatic agreements have also been used as a tool to streamline the environmental permitting process. Studying these relationships and different types of partnering agreements will provide insight as to how a project can be completed rapidly. These items include information about key relationships at various contextual levels pertaining to areas such as contracting, scheduling, community relations, project team members, political partners, and administrative processes. Through trust building and effective communication, as well as resource sharing, project delivery may be accelerated.

Acceleration through Organizational Issues that Are Not Project Specific

In many instances, projects are accelerated because of extreme circumstances, such as rehabilitations after a hurricane or repairs of structures after a collapse. Agencies prioritize a project and it is propelled through all phases until it is completed. Crisis management invokes a different set of principles by which engineers and designers are guided to complete tasks. These organizational issues can be studied to uncover what aspects of the process lead to an accelerated project. Similarly, such projects have a higher risk factor that DOTs are willing to accept as a project takes shape and begins to move forward. Although crisis management and related items will not be the focus of this category, methods and practices that surfaced during the crisis and were continued and weaved into existing programs, even after the crisis was under control, can be identified. Other factors such as management styles and methodologies of project managers, team member organization, and political support may make the difference between a project that takes a normal course and a project that is accelerated. These items include organizational theory and learning strategies for enhancing project performance through development of cultural dynamics responsive to scenarios involving multiple projects, decision trade-offs, the use of incentives, senior management perspectives, and theories of practice.

Defining Project and Program

Project

States have a clear understanding of what a transportation project means to them. A transportation project is a set of distinct activities, tasks, processes, or initiatives that result in a product or service and has a finite timeline. The end product may be a bridge, highway, railroad, tunnel, dam, or airport. Undertakings like these can be classified as large (or mega-project) investments. But in today's environment, smaller projects, such as those involving maintenance, minor repairs, resurfacing, and similar types of engineering and planning projects, have been taking center stage.

A project may also be undertaken to provide a service. Research-type projects often lead to a state offering a new service or implementing a new program. For example, a DOT may find through surveys and empirical data that passenger safety can be increased if it creates a greater awareness of the importance of wearing seatbelts. A study project may find that customers feel safer and more secure because of the roadside emergency service that some DOTs provide.

Projects may be viewed as piecemeal systems; however, this approach fails to tie projects to the overall strategies of the organization. The specific goals of individual projects may fall short of balancing with the organization's culture and mission. This is where programs fill the gap.

Program

The definition of a program varies among the state DOTs that were studied. To many, it meant a collection of similar-type projects grouped together. To others, a program was an endeavor to deliver a range of improvements. For instance, a state implements a program to improve the condition of their bridges, increase the pavement condition or ride quality, reduce congestion in construction zones, or reduce traffic-related fatalities through a guiderail installation program.

A broader approach to defining the difference between a project and a program is that a project delivers outputs while a program delivers outcomes (*2*). Programs seek to deliver long-term improvements and are aligned to an organization's strategic goals.

Project and Program Management

The use of the words "project" and "program" has changed dramatically as it is now inherently linked to the concept of project management. Project and program management is about integration. While project management is about "doing projects right," program management is about "doing the right projects" (*3*). Successful projects are delivered on time and within the budget and meet the needs of the original purpose. The success of a program is evaluated based on the benefits it provides. Program management requires a broader approach to coordinating and prioritizing resources across projects, while weighing their costs and risks.

In practice, there is no clear-cut distinction between transportation projects and programs in the states researched. Both projects and programs varied in size and complexity. Methods of project and program management varied even more from one state to the next. The definitions above provide a framework for how these terms will be used in the ensuing report.

The research revealed a common trend in defining the terms "program acceleration" and "project acceleration" among the various state DOTs interviewed. All the groups expressed the idea that the terms meant opening a facility to public traffic sooner or more quickly in one way or another. Some definitions pinpointed specific phases of a project, while others included methods or means for accelerating projects. In the end, it was concluded that finding ways to undertake processes simultaneously, in parallel, contributed greatly to accelerating project completion even if the individual processes took the same amount of time.

Researchers found that the technical aspects of developing a highway project or transportation program are a relative constant factor among all agencies. The core principles of engineering design do not change. The manuals that agencies follow for designing infrastructure remain relatively constant across the nation. Technological advances that expedite production are adopted in a relatively uniform manner from one DOT to the next. While geographical and environmental constraints may vary from state to state, the engineering aspects of project delivery remain the same.

Motivational Factors

The backbone of the U.S. economy relies heavily on the transportation system that moves people and goods. Four separate spheres make up the transportation industry: Planning/Engineering/Construction, Social/Community, Environmental and Political. Over the years, these spheres have become so interconnected that in changing one sphere, the other elements are affected, and all aspects of the project have to be considered before a potential project gains momentum.

Managers and decision makers have many reasons to accelerate projects. The research team asked a very fundamental question: What does acceleration mean to you? The question was then varied to ask what acceleration meant to their managers or supervisors, to the public/users, to the commissioner/executive director/secretary. The answers were found in their descriptions of project and program acceleration. Although the responses varied slightly, they all focused on the public welfare as the central reason to get facilities built faster. Figure 2 shows the motivational factors categorized as internal, external, and administrative/political reasons to deliver a facility sooner.

In candid discussion with the states that were interviewed, reasons for accelerating projects stemmed from the current climate of the transportation industry. The aging infrastruc-

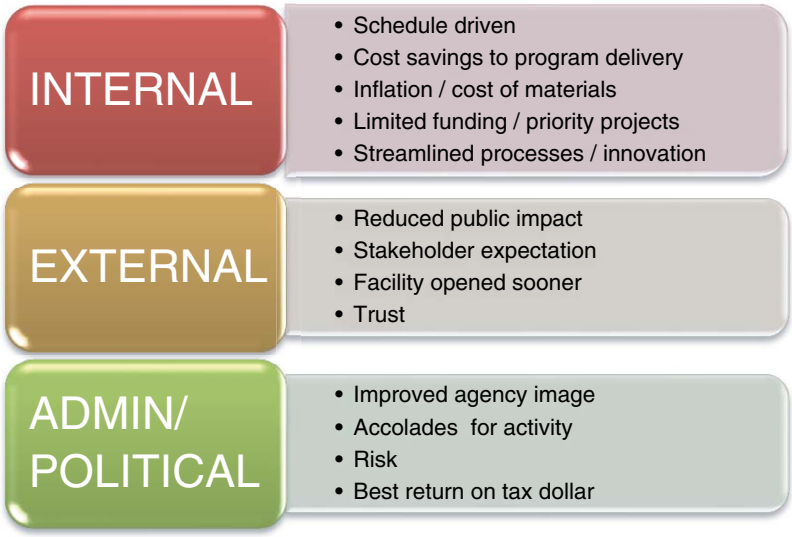


Figure 2. Motivational factors to accelerate projects.

ture that has provided a useful service life beyond the original expectations, a growing population whose mobility needs are increasing, increased congestion—especially in urban areas—that now impact daily traffic patterns, and limited financial funding all set the stage for the current transportation climate. This atmosphere encourages transportation professionals to bring the product or service to the public faster. They recognize the benefits of delivering a facility quickly to the public.

Internally, accelerating a project translated to cost savings in the overall program. Those savings could then be applied to other areas within the department or simply allocated to another project that lacked funding. In recent years, managers found that their projects were halted because of limited funding at certain stages of a project. For instance, a project could have been funded through planning and feasibility. But no funding was available for engineering and construction and projects were prioritized because of the limited funding. This combination of limited funding and shuffling of project priorities motivated some managers to accelerate their projects before the scenario changed again. Certain processes were designed to streamline critical aspects of a project. These processes assisted managers in expediting some phases of a project, which facilitated the overall delivery of a project. Inflation and increasing cost of materials were also reasons to accelerate a project and have it built sooner rather than later. The increasing cost of fuel and steel prices are evidence of the fluctuating market that influences the engineering and construction industries.

Externally, departments felt they had an obligation to meet stakeholders' expectations. The reduced time frames of delivering a project sooner reduced public impact, which translated to reduced user costs. In the eyes of the public, they needed to endure the rigor of sitting in construction-related traffic for only several months instead of a year or more. Departments were motivated to open a facility sooner because their reward was in the trust gained from the public.

From an administrative viewpoint, departments felt that accelerating a project meant that the tax dollar was wisely spent. Some states were enjoying the improved agency image from delivering a project ahead of schedule. This improved image allowed them to experiment with different options for other projects during construction. Another reason to accelerate a project was that not doing so was inherently tied to higher risk consequences. Not wanting to face the potential risk and residual risks were reasons enough to deliver the project quickly.

CHAPTER 3

Research Findings

To provide understanding of the full inner workings of the selected DOTs and provide some common points of reference for analysis, research was conducted on broader topics including organizational structure, project prioritization and selection, funding, performance measures, scoping and community involvement, property impacts, environmental concerns, and final design and construction. It is a given assumption that a state DOT is an organization with many units but with one pervading unity in function and alignment toward its mission. In attempting to meet its goals, the state DOT acknowledges and addresses the topics noted. The manner in which the integration and interactions of those elements with other internal and external factors takes place is what makes each DOT unique and what propels it forward. These logical assemblies of independent parts are what were researched in this study.

It is important to review the integration of those topics in the context of how DOTs set up their structure, operations, and programs. Within the organizational structure, one finds levels of hierarchy and formal and informal links that form the communication and reporting protocols. To some extent, the organizational structure influences the DOT culture and the individual performance standards for people, teams, and units. The operations of a DOT are defined through the processes and methods by which they deliver projects and programs.

Organizational Structure

Interestingly, the research revealed that each of the state DOTs selected for case studies had undergone some form of organizational restructuring within the last 10 years. There are many different types of organizational structures; however, most state DOTs can be characterized, generally speaking, as being either centralized or decentralized. It is evident that some states function optimally with a decentralized structure, while other states prefer a centralized office. Most decentralized DOTs have district offices that function like miniature DOTs, independent of the headquarters. The headquarters is consulted for major decisions, policy issues, and funding issues. DOT officials in large states such as California and Texas almost could not imagine being centralized and seemed to feel that decentralization lends itself to project acceleration, freeing individual district directors to focus on projects within their jurisdiction rather than having to wait for approvals and reviews from a remote central office. Decentralization in a large state also gives the public a "live body" to speak to, as opposed to an individual sitting in an office in the state capital located perhaps several hundred miles away. Smaller states like New Jersey, on the other hand, expressed that a more centralized organization reduced duplication of responsibilities and operated in a more efficient manner suited to their particular needs.

Many state DOTs have reorganized both internally and externally to provide for a more efficient delivery of programs and projects. The intent to reorganize was not always based on the need to deliver projects faster but rather on the realization that some form of efficiencies could be attained if the DOT reorganized parts of its structure. Organizations are becoming less vertical and moving toward flatter structures where more horizontal and vertical communication can occur.

In Missouri, the DOT organizational structure is overseen by a bipartisan committee, which may balance to some degree the political aspects of difficult decisions and allow professional judgment and functional systems to better influence project selection and implementation.

DOTs of some states that were researched have been able to maintain their staffing levels, while others have seen significant cuts in total staffing, requiring more outsourcing of project management and production. Staffing levels play an important role in deciding which projects are performed in-house versus those that get outsourced.

Another trend recognized in most of the states interviewed was that DOTs have introduced a project management philosophy or approach to project development. Project managers are finding themselves in an environment where their decisions

heavily impact and influence the outcomes of the project. There is a greater emphasis on the project manager's responsibility and ownership of project successes or failures.

DOTs such as in North Carolina have realized that "silos" created by the traditional vertical organizational structure often prevent projects from being accelerated or delivered completely. In many states, these silos have been or are being eliminated, and upper level managers are embracing the concept of "thinking outside the box," while they develop solutions that are based on outcomes rather than outputs.

The Maine Department of Transportation (MaineDOT) has found that a team approach has significantly helped in accelerating programs. These self-directed teams provide greater input, training opportunities and greater accountability for projects.

Project Prioritization and Selection

The state DOTs' approach to project prioritization and selection was found to depend on who was empowered to make decisions with regard to selecting and prioritizing projects. The role of decision maker usually went to the entity funding the project or their agent. Federally funded projects, in general, are prioritized by metropolitan planning organizations (MPOs) that employ a quantitative transportation planning approach in developing a list of needed projects. Research revealed that in cases where projects were funded principally or entirely by the state legislature, that body—or individual legislators—had the ability to raise a project's priority by designating funds to build it. Whether state or federally funded, however, both legislatures and MPOs utilize a systematic approach to transportation project prioritization.

Most state DOTs also use traffic volumes and truck traffic data indirectly in the prioritization process. Along with vehicle delays, safety elements, and potential future growth, these quantities are important factors in overall road user costs and life cycle projections.

Funding

As alluded to in the preceding paragraphs, the mix of federal and state funding for DOT projects was found to vary greatly from state to state, with some having 80 percent or more of their transportation budgets funded through their state legislature. Other states are much more dependent on federal aid, receiving almost all of their funding through U.S. congressional allocations. Regardless of their major funding source, all states studied have been confronted with the need to "do more with less," as funds have become scarce. In addition, projects funded even partially with federal dollars are required to undergo federally established planning and environmental analyses; only projects funded entirely by the state are subject only to state regulations. States own and operate all the federally funded roads within their boundaries.

Where projects are predominantly state funded, another dimension is added to project acceleration: There is usually strong political backing and impetus to get a project completed quickly, because elected officials want the ability to say to the public, "This is what I've accomplished during my term of office" before they are up for re-election (within two years).

It was also noted during the research that the sooner and more quickly a project is built, the lower the cost of the materials. This is obviously an additional incentive to accelerate a project.

Officials at the California Department of Transportation (Caltrans) mentioned that consistency in funding accelerates projects, while fluctuations in funding availability results in project delays.

MaineDOT is utilizing public–private partnerships (PPP) as an option for funding and construction when developers need a traffic permit to open onto state roads. Transportation improvements are coordinated with private investments and applied to localized improvements. For example, the DOT might negotiate a deal with a superstore chain to pay for an extra turn lane at an intersection project and then use the funding to supplement a total reconstruction project for the intersection. Maine feels that PPPs are an important tool that is still underutilized.

Performance Measures

Performance measures are a key concentration area for most DOTs interviewed. With the exception of one, the DOTs researched are in various stages of collecting data and information that is used in performance measures. Some states are quite advanced and have performance measures in place that help agencies to communicate needs and priorities to the public and decision makers. The North Carolina DOT (NCDOT) has an online performance "dashboard" that is tied directly to the agency's success in meeting its fundamental goals and can also provide real-time statistics at the county level. Performance measures may also help agencies make better decisions to address long-range goals, system performance, and immediate outcomes.

When developing performance measures, DOTs have discovered that there is often no baseline for comparisons, because performance was not measured previously. In addition, no standard guideline exists against which to measure current performance. At their most basic level, performance measures can report on a host of varying things such as pavement conditions, safety, bridge conditions, crashes, injuries, travel times, and congestion levels. Moving from mere outputs to outcomes, successful performance is expressed in a variety of ways such as service quality, efficiency, productivity, and

return on investment. Performance indicators can be measured in numerous ways, each of which may suggest different problems and solutions.

Further complicating the issue of performance measures are the methods and techniques used to report performance. Formats such as scorecards, dashboards, and roll-up or drill-down features are used for both internal and external reporting but these all vary from state to state. Numerical targets vary, as do baselines, benchmarks, and levels of data analysis. Sufficient historical data does not exist for many states, so it is difficult to quantify whether changes in a process or a management approach have led to significant positive impacts, and if so, to what extent.

Using performance measures is a strong trend that was identified in the interviews. Equally important is the concept of transparency. Many states recognized that by becoming more transparent to the public, they would be able to impose slightly more inconvenience to the motoring public as long as they delivered what was promised, on the date promised. Becoming transparent and informing the public by creating an awareness of upcoming project schedules has allowed states to deliver projects more quickly and build credibility at the same time. Through the use of performance measures, DOTs have become more accountable internally as well.

Some of the state DOTs studied have a performance dashboard accessible to the public on their website. Others, such as the Utah Department of Transportation (UDOT), conduct a Regional Program Dashboard Update, which provides an internal look at where individual regions stand with their projects as a whole. Maine has an internal system of tracking projects that move from green to yellow to red categories, each of which defines the project and associated issues. Maryland DOT has published an Annual Attainment Report for seven years that includes dozens of charts and graphs that track the DOT's performance from year to year. The Missouri Department of Transportation (MoDOT), which publishes *Tracker* on a quarterly basis, has been reporting on performance statistics since 1999. One Caltrans official aptly stated, "What gets measured gets done."

Agencies that have implemented performance measures have expended a great deal of time and effort to get to the point where they feel they are measuring the right things. A difficulty the researchers encountered in trying to draw conclusions from performance measures is that it is not possible at such an early stage to make comparisons between acceleration of past and recent/current projects. Another problem with comparisons is the fact that no two projects—no matter how similar—are surrounded by identical circumstances. Each project takes place in a unique physical, financial, social, and political environment.

There are, however, some measurements that can be taken and compared with historic records, for example, the percentage of listed projects that go out to bid in a given year. Regardless of the magnitude or nature of the project, this measure can be taken for the current year and compared to the same measure over past years.

Scoping and Community Involvement

A critical aspect of accelerating programs is to determine early on that their components can be designed and constructed in the later phases. This aspect begins with scoping and maintaining the established scope throughout the life of the project such that the purpose and need are met. Often, projects go off track in trying to meet the expectations of the stakeholders. Stakeholders are disappointed when the state cannot accommodate or complete a project as per their requests. This disappointment creates distrust of the government and slows progress altogether. States, such as Missouri with its practical design, are finding that a clear, concise, implementable scope that is developed early in planning—and then maintained through permitting, design, and construction—clears the path for an accelerated project delivery. Also, states are turning to management systems, asset management, and information systems to provide clear and direct responses to the requests of stakeholders and elected officials.

Early community involvement was viewed by all the DOTs studied as an aid in expediting projects. There was a general consensus that time spent early on in the planning phase of a project paid big dividends in the form of time saved later through the elimination or reduction of revisions and delays. Some DOTs have adopted a public relations approach that directs public attention during the sometimes difficult construction phase to a project's positive attributes, presenting any temporary negative impacts (closings, detours, etc.) in the light of the long-term benefit to the public. Again, the individual state's size and population density, and a road's daily traffic volumes and available alternate routes, are all determining factors in the range and degree of interruptions a given transportation facility—and its users—will tolerate. In some states, the temporary closing of an interstate highway is a viable construction alternative; in other states, this would be unthinkable. Both Caltrans and UDOT pointed out that even severe interruptions to traffic will be tolerated by a public if they are provided with expectations and the agency delivers within the promised time frame.

Property Impacts

The impacts of projects and construction on adjacent properties presented a range of difficulty levels to the various DOTs interviewed. For New Jersey, with an average of 1,175 persons per square mile, real estate is expensive and ROW acquisition holds a prominent place on the project schedule, to the point of being on the critical path. If a property taking goes into litigation, several years may transpire before construction

can begin or resume. In contrast, in Utah, which has an average of 31 persons per square mile, the DOT has been successful in acquiring rights of entry to properties so that construction can proceed while the acquisition and negotiation processes continue.

Environmental Concerns

One acceleration method used by the Texas DOT (TxDOT) during design–build of a highway through a sensitive habitat area was to purchase in advance tracts of mitigation land outside of the alignment. This land provided the TxDOT with a surplus "bank" of sensitive habitat acreage to mitigate any negative impacts that might be created during construction of a highway, eliminating the need to shut down construction and acquire mitigation parcels piecemeal as sensitive land was encountered. TxDOT also has advanced the design process on a project while the environmental review was still under way. Admittedly, this was taking a risk, but it was worth the time saved when the project was so much farther along in design at the time environmental approval was granted.

North Carolina and Maryland are able to accelerate the environmental review process by partnering with their respective department of environmental protection to fund employees dedicated to reviewing DOT projects.

Maryland places a great emphasis on its environment. Its spends almost 45 percent of its capital program on preserving the environment. However, acceleration of projects is achieved through creating interagency work groups that meet on an as-needed basis. Maine also recognizes the need to protect its environment through programs that help reduce emissions by using cleaner fuels, reduce the statewide VMT, and make balanced decisions for communities that are impacted by transportation projects.

Some of the projects undertaken by UDOT are exempt from the National Environmental Policy Act (NEPA) review process because they are entirely state funded and require no federal permits. For such projects, UDOT has its own environmental review process that generally goes much more quickly than a NEPA review—one year, as compared to two or three years for NEPA.

Final Design and Construction

The research revealed various forms of innovative contracting:

- Design–build—Allows construction to begin prior to completion of final design. This parallel processing has been very effective in states such as Maryland in accelerating project startup and therefore ultimate completion. The risk with design–build is that construction might be started before all of the environmental permits and/or approvals have been granted. The Maryland State Highway Administration (SHA) has enjoyed success with its design–build program and spends approximately 10 to 15 percent of its construction dollars for design–build contracting methods.
- A + B contracting (biparameter bidding)—Includes built-in financial incentive for the contractor to complete a job on or ahead of schedule, as well as disincentives for not finishing on time.
- Construction manager–general contractor (CMGC)—Improves on the benefits of design–build by bringing a contractor to the table early in the design process. Pioneered by UDOT, this method realized a time savings of 18 months on a recent bridge project because it allowed fabrication of steel girders to begin while the project was still in the design phase. Design was completed in parallel with the long lead time associated with ordering steel.
- Evergreen contracts—On-call or task-order agreements with professional service consultants eliminate having to go through the entire procurement process in the event that they are required on individual projects. Texas uses these types of contracts on a regular basis.
- Comprehensive development agreements (CDA)—Agreements between a state and a consortium of contractors. Texas uses CDAs to perform all or portions of a given project's design, construction, operation, and maintenance.

The research also revealed acceleration of construction taking place through:

- Roll-in of prefabricated bridges—where land is available for staging, a bridge can be demolished and a prefabricated bridge can be rolled in and operational on the same day (usually executed on a weekend night). This method of construction has been used in New Jersey in areas where railroads are involved and the state has a very limited window where passenger service can be shut down.
- Use of new products and materials—Almost all states were experimenting with new types of products and materials that are available. Materials that provide better bonding, faster curing times, greater load-carrying capacities, ease of construction, etc. are being used to accelerate the pace of construction. States are making strides in terms of trying new products that will provide them with better quality and extend the life cycle of the facility.

CHAPTER 4

Accelerating Program and Project Delivery

Constraints to Accelerated Delivery

In 2000, the FHWA Office of NEPA Facilitation conducted a study to identify the causes of delays greater than five years for transportation project environmental impact statements. This nationwide study looked at 89 projects and identified that 57.5 percent of the projects had been active for five to seven years, 28 percent had been active for eight to ten years, and 14.5 percent had been active for more than ten years. The top four single reasons given for the durations of the projects were lack of funding (18 percent), low priority (15 percent), local controversy (14 percent), and complex project (13 percent). (*1*) While some of these reasons may apply across the board, they may be more pronounced in projects that require extensive environmental permitting.

This research, in part, attempts to identify elements that derail projects from their onset to the very end. Because derailing elements were not the focus of the project, no attempt was made to collect quantifiable data to determine exact time frames for the delays. However, conversations with interviewees at the eight researched state DOTs indicated some very specific areas where delays were encountered in projects. DOTs have found time and again that certain elements of a project traditionally cause delays. As a result, these areas are where states are implementing new processes to help expedite or facilitate the momentum of the project. Areas of delay were found to be (a) utility coordination and relocation, (b) railroad coordination and involvement, (c) ROW acquisition, (d) interagency coordination, and (e) lack of funding.

Utility Coordination and Relocation

Projects that involve multiple utility relocations often experience delays at some point in the project—either during the design phase, when coordination is instrumental, or more typically during construction, when relocations are critical. Part of the struggle for DOTs is that utility companies are expected to simply relocate their facilities to accommodate the state project and are offered minimal compensation for it. However, utility companies prioritize work that returns a revenue stream for them. Another issue is not that utility companies do not want to "help," but that they are struggling with their own resources; therefore, allocating field personnel to a DOT project may be difficult if they have other emergencies to handle.

Another issue is that utility lines are inherently not apparent. It is difficult to determine the exact location and depth of subsurface utilities—so the actual work of identifying and relocating utilities is difficult, especially in urban areas. Subsurface utilities that were installed decades ago pose their own set of challenges when it comes to relocating them.

Railroad Coordination

Railroad involvement in many projects continues to pose challenges for project delivery. State DOTs are often faced with the challenge of having to design and construct highway projects across railroad properties. Similarly, railroad project managers often face difficulty in meeting the state's needs while operating within their complex operational and organizational structures. Railroad facilities—including tracks, bridges, drainage structure, trackside equipment, communication and signal systems, warning devices, and electrical/mechanical housing—have to be incorporated into the roadway plans. Due to the extremely high cost of shutting down a railroad line and its subsequent economic impact, any encroachment onto railroad right-of-way (horizontal or vertical) that could potentially affect railroad operations must be thoroughly reviewed and resolved. The most innovative examples of railroad/highway projects involving structures have included methods that replace entire bridges and overpasses over active rail lines.

Perhaps because railroads have predominantly operated and existed as private entities in the past with little need to coordinate with other agencies, this emerging necessity to begin coop-

erative coordination is a hurdle for many. Transportation engineers' experience with or perception of railroad entities has been expressed as "railroads are difficult to work with." This perception may stem from the fact that railroad operations can rarely be interrupted and public passenger/transit service must be provided at all times.

Railroad engineers have different standards, specifications, and requirements from those outlined for roadways. Railroad priorities differ from roadway priorities in many cases. Because of these differences, design and constructability issues require much more coordination effort from both parties as early as scoping and concept development.

Right-of-Way

Traditionally, delays in ROW acquisition occurred when the ROW function was not integrated during project development. Property owners were unwilling to sell or accept market value for their property. Projects came to a halt until such issues were resolved, which could take months for a court ruling.

Each state has different legal framework regarding acquisitions and property owner rights. Other factors that vary greatly from state to state and from region to region include population density, intensity of land use, and local real estate values. While acquiring acres of undeveloped right-of-way for an entirely new alignment may be completely feasible for a DOT in some parts of the country, the dollar cost—or the environmental impacts—of obtaining the right-of-way needed just to widen a highway, especially in a densely developed area, may be so prohibitive as to stall the project indefinitely.

Interagency Coordination

States continue to make great strides in coordinating with state and federal regulatory agencies and local governments that may be involved throughout the life of a project. These efforts in part stem from traditional long-review time frames from permitting agencies, time wasted in "re-dos" because reports did not include the right information that the reviewing agency was looking for, lack of frequent communication, and differing priorities. State DOTs have seen the benefits of proactively coordinating with regulatory agencies (such as the FHWA, Environmental Protection Agency, U.S. Coast Guard, state historic preservation offices, MPOs, etc.) to understand the issues better and foster trust between them.

Programs that include context-sensitive solutions and environmental streamlining and stewardship have helped create links across agencies and levels of government. However, there are still some barriers that prevent transportation programs from moving forward when there is a lack of communication, coordination, and collaboration between the agencies. These differences on key issues lead to negative impacts on the delivery of the project and may bring the issue at hand—delivering the facility to the public efficiently and at a reasonable cost—to a standstill. While many states continue to build positive relationships with their local governments and permitting agencies, there remains a gap in seeing the transportation issues as a mutual concern. State agencies need to work across traditional barriers and find innovative solutions that use collaborative techniques to solve transportation problems. Even though many states have programs that engage and involve local participation from both agencies and the public, the commitment or resources may be lacking to support more intense collaborative efforts.

Some states do not have the organizational structure for a collaborative decision-making process. Such an organizational structure is perhaps more frustrating when it limits individuals from making the right decisions that shape the future of their immediate environment. State transportation leaders need to continue to involve the public and agencies in the decision-making process so they have ownership and a sense of investment in the solutions that are developed. (*2*)

Lack of Funding

Consistently, the research team found a common thread across all states that were interviewed: a lack of funding. The changes that have occurred in the transportation arena over the last 50 years are dramatic. The late 1950s through the 1960s were marked by tremendous growth and building of the National Highway System. Rarely has an investment been so profound as to have such a great impact on the citizens of America, their economy, and mobility options. But in that same period, growth in all other facets of American life has proven to take its toll on the highway system. Decades of population growth have resulted in rising mobility needs which in turn have increased the VMT on the roadway network, particularly in urban areas. Table 1 shows the rapid growth in population and associated demand for VMT. Forecast figures are based on the historical trends.

Table 1. U.S. population growth and vehicle miles traveled, 1955–2055.

Year	Population	VMT
1955	145 million	0.6 trillion
2007	300 million	3.0 trillion
2055	435 million	7.0 trillion

Source: Lee, Joung H. Transportation Funding Challenges Facing the United States. Presented at the North Atlantic Transportation Planning Officials 2008 Annual Meeting. Niagara-on-the-Lake, ON. August 2009. http://www.transportation.org/sites/aashto/docs/Lee-2008-08-12.pdf

In response to the growing need to fund the maintenance of their transportation systems, states have developed a number of innovative approaches to reduce the cost of planning, developing, and constructing a facility. From innovative financing options—such as congestion pricing, Grant Anticipation Revenue Vehicles (GARVEE bonds), Transportation Infrastructure Finance and Innovation Act (TIFIA) loans, and freight user fees—to public–private partnerships, states continue to look for ways to use tax dollars wisely and economically. The lack of funding has also initiated many programs such as practical design, performance measures, asset management, and Merger 01 that address the state's transportation system as a whole and attempt to address the issues using a holistic approach.

State DOTs are finding that the monumental era of building highways and bridges has given place to an age of maintenance and preservation. Times of building to the highest design standard have yielded to a more flexible approach in designing a practical network. Transportation planners used to change the surrounding landscape to allow a road to pass through; now they try to change the road to fit into the existing environment, without trying to alter too much of the canvas. Times of unlimited funding have disappeared, to be replaced by economic and financial constraints that cannot meet the growing need to address our deteriorating system of highways and bridges.

Shifts in DOT Cultures—The Intellectual Revolution

The last two decades have brought about many shifts in culture, within transportation departments and in other agencies as well. Changes in the economy, funding levels, the state of the nation's infrastructure, organizational structures, and management styles—along with the diversity of multiple cultures and languages, and inclusive workforces spanning from baby boomers to Generations X and Y—have brought about shifts in DOT cultures. Many DOTs have experienced true paradigm shifts—the result of an extensive process that brings about major revision to methods and ideas leading to a transformation of vision among their practitioners. (*4*)

DOTs commonly have long-established processes, identified tasks, well-defined roles and responsibilities, and standard ways of delivering their programs and projects. Disciplines and sectors throughout the industry share a comprehensive understanding of this world view that brings forth the worth and value of their work. While minor changes in work flows or individual units do not typically shake the foundations of a DOT as a whole, major paradigm shifts—fundamental changes in the way business is done—represent a progression from the established framework into something quite different and new. As such, a change in paradigm characteristically meets with resistance and rarely entails smooth transitions.

The paradigm shifts that have occurred at many state DOTs involve progress. This is a fundamental necessity. New discoveries, new experimental results, and models that do not fit in with known theories, or anomalies in data and information, often set off a chain of events that build momentum toward a cultural shift. Crises often lead to paradigm shifts; moreover, they force leaders and decision makers to see their world differently. (*4*) After the Interstate 35 bridge collapse in Minnesota, for example, federal and state policies regarding bridge inspection cycles changed. Within a month or two, state DOTs across the nation were inspecting their bridges more frequently.

The DOTs of today and their leaders see the transportation environment in a very different light than they did two decades ago. First, loyalty in the new paradigm is not as much between the agency (DOT) and the client (stakeholder); it has shifted more to the problem at hand. Whether it be a capacity issue or a safety concern, a congestion problem or an operational challenge, the transformed DOT culture focuses on solving the problem with swift conviction, within the real constraints being faced.

Second, the studied DOTS exhibited some form of sustained capability that emphasized greater accountability on the part of their managers. Accountability was closely linked to a *kaizen*-like evolution that encourages a continuous improvement of processes, materials, and personnel. State DOTs are implementing programs that reward individuals who think outside the box and improve processes to achieve greater efficiencies and commending those who meet and exceed established goals. This approach promotes highly motivated individuals and fosters a balanced growth environment in which employees can experiment, take prudent calculated risks, develop new ideas, and implement practical solutions to solve problems. Principles of ingenuity and accountability are interwoven into the new paradigm.

Third, this new paradigm values economies of scale in the execution of projects and programs as much as it does paying individualized attention to the smaller "meat and potatoes"–type projects that fall under its umbrella.

Fourth, because most transportation challenges cannot be solved through singular relationships, today's DOTs seek to collaborate and partner with the many stakeholders involved. This collaboration is sought not only for financial stability and leverage, but also for planning and execution. External relationships are cultivated and honored; under the new paradigm, stakeholders are brought in early as participants in a partnership set up to solve the transportation problem, rather than as "clients" whom the DOT as "vendor" is tasked with satisfying. Transparency and accountability on the part of the

DOT go far to help stakeholders see the complexities and ramifications inherent in a project; they are less likely to clamor for costly embellishments when they see that trade-offs, compromises, and negotiations are required from all quarters to reach the best solution.

Interagency collaboration is another type of partnership sought under the new paradigm. Policies established to protect the natural and built environment during the interstate highway era empowered government regulatory agencies with review and approval authority over proposed transportation projects. State DOTs have found that treating transportation issues as mutual concerns, not only between the DOT and stakeholders but also between the DOT and these counterpart agencies, results in forming peer relationships between the agencies involved, with a push toward collaborative leadership. Compared to an adversarial approach, peer relationships build a sense of trust and common ground from which all parties can begin a conversation and "speak the same language," because the ultimate goal serves the same public. Information flows both ways, and strategies can be aligned in a way that allows programs and projects to be implemented and constructed more expeditiously. "Accountability is mutual; transparency is valued." (*5*) Because work flows under the new paradigm are no longer linear in nature, multipronged approaches can be employed to solve today's complex transportation challenges. Collaborative leadership begins with the premise of a shared vision and confronts both the issues and their solutions by sharing responsibility, authority, accountability, and the successes that result when synergies occur. Everybody in the organization, at all levels, is fully engaged in achieving the common goal. (*6*)

Fifth, the new paradigm takes into account the advent of an emerging global economy in which technology and communication are central pillars in any organization that wants to compete in the global marketplace. Many states have invested in advanced technologies, allowing their DOTs to operate more efficiently, obtain real-time data, communicate instantaneously, and disseminate information more rapidly than ever before.

The transportation industry has undergone a dramatic transformation. In comparing the DOT cultures of today with the prevailing thought of the 1980s, "the new paradigm shifts imply new skills, enhanced relationships, new pathways of accountability, new standards of performance, and new criteria for decision making. These imply a very, very different kind of culture than in traditional . . . approaches." (*5*) In some instances, paradigm shifts might have been perceived as radical, revolutionary attempts to overhaul the DOTs. In fact, it is safer to say that they were evolutionary changes that brought about new ideas, identities, innovations, and ideologies.

Trends and Challenges

Transportation engineering projects and programs are unique challenges in comparison to mass production or advanced technology–type endeavors. The difference is that the final product is a one-of-a-kind facility that exists in its own setting—a road that is built through extreme topographic features or a bridge or tunnel that is constructed to provide passage for motorists and navigable vessels alike. Each becomes a hallmark that carries in its history an intense interaction between client, consultant, and contractor—a process of negotiations (financial, design, and aesthetic), regulatory challenges, partnerships with government agencies, and a champion that brings the project or program to maturity and completion. These factors alone make it difficult for DOTs to accelerate projects and programs. Yet many states have found ways to deliver their programs and projects more quickly.

In the course of preparing case studies, reviewing existing literature, and conducting interviews with representatives of the state DOTs, several salient points became evident. Some of these trends were noticed not only in the DOTs interviewed but also in the websites of other agencies and various other current information sources. Challenges were also noted because they pose opportunities for improving current practices and give a more realistic glimpse into the future of state transportation agencies. Many have already recognized and identified core areas for improvement and are taking steps toward that end.

The following list of trends and challenges is not exhaustive, but rather representative of the main points that surfaced. Likewise, the order in which they are presented here is not intended to be indicative of their importance or ranking.

Trends

Performance Measures

There has been a deliberate effort by many states to develop or formalize performance measures. Some states have attained a level of maturity with their performance measures after years of developing and refining them, while other states are just beginning the process and realize that they have a long journey ahead of them with this undertaking. For the most part, all states interviewed have at least established some means of measuring their transportation infrastructure, from something as simple as logging pavement conditions to developing elaborate online system-wide measures, fully accessible through the Internet.

Research carried out for this project indicates that state DOTs are increasingly identifying performance measures as one of their most pressing needs. More and more states are incorporating performance measures into their operational

procedures and implementing ways to improve their transportation systems and the operations that create and maintain them. From the simplest measure of crash rates from one year to the next to more complex outcomes such as measuring customer satisfaction or stakeholders' quality of life, there are countless ways of measuring a DOT's performance. Within the framework of performance measures is incorporated policies, systems, programs, financial investment strategies, and project-level objectives.

The states studied for this project all measure performance—formally and informally—on varied aspects of program and project delivery. Also varying from state to state is the extent to which performance is measured and the purpose for the measurement. Some states use performance measures for evaluating infrastructure conditions, such as pavement surface smoothness or the structural capacity of a bridge. For example, New Jersey has excellent data regarding the pavement conditions because it is a relatively easy index to measure. Traffic congestion and other factors are also measured; these factors are then used to classify the condition of the entire transportation system. These measurable factors are also now being applied to develop New Jersey's asset management approach.

Some states track the performance of both the transportation infrastructure and the agency that delivers and maintains it. As the name suggests, the *Tracker* is Missouri's instrument for monitoring how the state is doing in meeting its performance goals on 18 tangible results. It provides a window for the public to view the agency and hold them accountable for attaining the expectations they have set. Measures for such things as uninterrupted traffic flow, transportation system safety, environmental stewardship, and innovative solutions are a few of the results that Missourians expect. Published as a printed document as well as being accessible online, the measures in the *Tracker* are updated on a quarterly basis.

MaineDOT instituted an internal performance review in 2004 known as "Quality Assessment of Completed Bridge Projects." Work performed on various bridge projects was scored on a scale of 1 to 4 ("unsatisfactory" to "exceptional") in terms of safety quality, environmental compatibility quality, functional quality, cost-effectiveness quality, and overall quality. Maine developed a different measurement system to track performance on projects identified in the Biennial Transportation Improvement Program (BTIP) and Maintenance Activity Plan (BMAP). An internal dashboard classifies newly kicked-off projects as green, then as they progress they are indicated as green, yellow, or red depending on how consistent they remain with the Scoping Report, how close expenditures stay within the programmed amount, and how well they adhere to the schedule.

California uses performance measures for strategic planning and management. Upper management at Caltrans has focused on strategic objectives and organizational goals and has seen results. Individual performance contracts hold managers accountable for reaching their targeted goals. Managers sign performance agreements for the delivery of their programs; their individual job performance is evaluated based on their success in attaining these goals. This type of initiative provides powerful results, lending credence to the maxim, "what gets measured gets done."

Performance management has been used at the Maryland State Highway Administration (MSHA) for nearly 10 years. An in-depth business planning and performance measurement (BP/PM) plan includes approximately 400 measureable goals. Maryland has used performance measures for budgeting and programming, program management and project delivery, operations, and monitoring results, feedback, and communication. (*7*)

The way in which performance measures are conveyed to the public also plays an important role in the public's perception of the agency. For instance, North Carolina displays its organizational performance measures in a dashboard format that the public can access on the state website. There is a simplicity about the gauges on the dashboard; indicators communicate to the public where and how—and how effectively—their tax dollars are being spent. Behind the dashboard are numerous real-time data collection and reduction efforts, complex logarithms and analyses that convert raw transportation numbers into measures that users can relate to. California has a similar display featuring an "odometer" dial, while Missouri uses a multipage report-style format. What is quite clear in all of these agencies is that the public has developed a high regard for the direction that their agencies are moving in and a sense of trust in the decisions being made.

The manner in which performance measures are used, reported, or communicated and the way they are used in decision making varies with how formalized their implementation is and how integrated the program is with the rest of the DOT's procedures and operations. For example, Caltrans uses performance measures as a cornerstone for delivering their programs. It is a formal approach, heavily incorporated in their policies and procedures.

Outcome-based performance measures require a great deal of effort to implement as compared to output-based ones. Outputs are quantitative units of service regarding a program, for example, the number of programs funded, projects designed, contracts let, lane-miles constructed, etc. By themselves, numbers don't always paint a clear picture of the actual impacts/benefits/changes to the public, the transportation agency, or the highway system—the number of miles driven, for instance, merely indicates the numerical quantity of vehicle miles traveled in a given period. Outcomes, on the other hand, are the impacts/benefits/changes experienced as a result of a program's or project's implementation. For example, for a maintenance program, an outcome might be "percentage of the

state highway network in overall preferred maintenance condition." (Notice that this outcome is quite different than outputs, such as the "number of lane-miles resurfaced.") Outcomes are usually expressed in terms of having short-term, intermediate-term, or long-term effects.

It is relatively simple to populate a table with statistics and then present the information—the output—as a graph or chart. Measuring outcomes, by contrast, mandates iterative, collaborative processes in which problems are identified, needs are assessed, attainable goals are established, and a commitment is made to revisit and adjust established goals and continue to identify new ones as earlier challenges are met and operational hurdles are overcome. Developing outcome-based performance measures requires the consensus of leaders and subject matter experts from a transportation agency's various divisions, disciplines, and districts, each of whom brings their unique set of goals, needs, and challenges to the table.

Performance measures are important because they showcase the tremendous needs state agencies face and build confidence that the agencies are spending tax dollars wisely. They provide a customer-based focus that helps state DOTs address public concerns and build public trust. They help ensure cost-effective use of limited funds; provide a tool to improve areas where progress needs to be made; and serve as a barometer on internal performance, delivery, and overall effectiveness.

A Front-End Approach (Planning, Scoping, Purpose, and Need)

A shift has occurred in the way projects are developed. The traditional approach placed greater emphases in the design activities and phases. For instance, the final design and environmental permitting phases of a project often garnered the most attention and support and were allotted the most time for execution. Current project development approaches focus on thoroughly outlining the purpose and need, carefully defining the scope to considerable detail, and outlining the front end of the project even before the feasibility assessment.

The front-end approach involves the development of strategic information sufficient for owners to address risk and commit resources to maximize the chance for a successful project. (*8*) Defining the activities involved in the front end differs between state transportation agencies. It is not always clear where the front end ends and the mid-section and back end begin. For instance, some states consider all planning-, scoping-, and purpose-and-need–related activities to be part of the front-end process. The back end constitutes design, bids received and awarded, and construction-related activities through closeout. Some states include several preliminary design functions in the front-end process. A 2008 study on front-end planning processes found a statistical significance in the correlation between 7 out of 33 activities performed in planning at the front end that contributed to project success. Of those seven, public relations, scope, and execution planning can be directly related to project success. While most states do not formally segment their work into front-end and back-end tasks, it is safe to say that much effort is being expended at the front end.

North Carolina divides highway projects into preconstruction and construction, akin to front end and back end, respectively. NCDOT managers place much emphasis in the planning aspects of a project, particularly in coordinating efforts with all of the stakeholders and regulatory agencies, striving to gain concurrence at critical milestones during the planning and design of a project. New Jersey DOT's pipeline process follows an activity manual that defines over 60 possible activities in the purpose and need and feasibility assessment phases of a project alone. Caltrans performs a certain degree of risk assessment at the front end of a project to avoid costly oversights and budget overruns. Most state DOTs use front-end planning to assess the business requirements, select the right technologies, define the scope of work, assemble a team, perform a risk analysis, develop the contingencies, and obtain buy-in from the decision makers and stakeholders.

In effect, DOTs are stretching out the front end. Time spent during this period, project advocates have realized, is conducive to sound decision making and creating added value. Uncertainties—as well as their solutions—are only revealed over time, through the repeated interaction of stakeholders, specialists, and partners. Successful projects require a front-end process that builds trust among stakeholders and sponsors in order for all parties to learn from one another and maintain flexibility. No one can determine the exact amount of time needed to build trusting relationships at the front end. This phase can be a costly component of the project when all is said and done, but there is no question that extra time spent at the front end becomes an ally to project acceleration, affording flexibility and better decision making, and often expediting design and construction when the project evolves into a "win-win" during the development phase.

In the engineering and construction phases, where expenditures on a project multiply rapidly, there is little to be gained by waiting. Time erodes value at the back end of a pursuit. This is the place where programs and projects benefit most from being accelerated. Speedy delivery of projects at the back end, from the onset of design to revenue generation, is of the essence. Furthermore, if projects take too long to implement, administrations change, policy changes, priorities change, and projects don't get built. It is crucial to strike while everyone is in agreement.

Project Management

The Project Management Institute (PMI) has formal processes and procedures stating how a project should be managed, from project initiation to execution to closeout. More

state DOTs are beginning to use PMI philosophies to deliver projects. Project managers are cognizant of the quadruple constraints of a project (scope, schedule, budget, and quality) and are applying them more and more in their daily program or project management activities.

While there are many definitions of a project manager, essentially he or she is at the center of orchestrating the efforts and activities required for final deliverables through forming alliances and providing direction, motivation, and leadership while optimizing time, cost, procurement, quality, communications, risk, scope, and human resources. Another definition characterizes a project manager as "a businessman, a psychologist, an accountant, a technician, part designer, part nuts-and-bolts—a truly rare combination of skills." (*9*)

Over the last two decades, state DOTs have placed a greater emphasis on the concept of project management. With formal processes adopted for project initiation, planning, execution, monitoring, and closing, there is a concerted effort to take a project all the way from its first idea to completion. New Jersey and California DOTs have adopted formal project management approaches to project delivery. Both states use comprehensive project management manuals and training programs to groom potential project managers and empower them with the skills to take a project from start to finish. Since 2000, Maine has made changes in its DOT that formalize the role of the project manager, involving him or her in a project from its planning phase through construction.

Successful project management requires the right organizational climate as well. It requires support from upper management, an alignment of project management processes with the goals and missions of the organization, a formal process for project management, and a culture that supports the project manager and project management efforts, including training. MaineDOT has an excellent cross-training program that allows a project manager to experience first hand all the phases of a project's life cycle by allowing him or her to follow the project all the way into construction, where the project manager assumes the responsibilities of a resident engineer. This program provides the individual with exposure, experience, new skill sets, and a better understanding of the project management process, as well as many aspects of a transportation project that might previously have been unfamiliar to the individual. Some state DOTs have also provided project managers with the ability to execute projects more efficiently. Being the single point of contact from the inception of the project to its completion allows the project manager to be in tune with every aspect of the project. The greater advantage is the consistency gained in project delivery. The project manager essentially becomes the champion for the individual project.

Leadership

Leadership plays a critical role in how quickly programs are implemented and executed. Leaders of organizations must have the ability to orchestrate the dynamic interplay that must occur between individuals, work teams, agencies, and stakeholders for an initiative to go from inception to fruition. Leadership at the very top, in many states, is a politically appointed position. The commissioner's or secretary's tenure in office and ability to effect change are often limited by the duration of a given governor's term or political party's majority. In recent times, the average length of stay for a DOT commissioner in New Jersey is three years.

Unlike many other states, MSHA and Missouri DOT are exemplary in having had a continuity of leadership rather than the transitory leadership characterized by politically based appointments. In Maryland, this continuity and strength in leadership has allowed the Intercounty Connector to advance to construction after five decades of controversy and opposition. Strong leadership at the very top—its direction and guidance—sets the stage for all other performance. The positive influence, practical optimism, and depth of experience provides for complex coalitions to be strengthened, difficult decisions to be made, funding to be secured, and solutions to be implemented that culminate in value-added final products.

Communication, Collaboration, and Cooperation

The ability of state DOTs to reach out to their internal and external stakeholders, regulatory agencies, clients, and elected officials in an effort to advance and deliver programs has never been so great as it is with today's technologies. State DOT employees are communicating laterally and vertically, collaborating to reach difficult project and program decisions, and cooperating to meet their end goals. This effort has led to true "partnering" among agencies and the fostering of relationships based on trust.

If one considers the many external agencies they must collaborate and communicate with on a single project, state transportation officials virtually function within an expanded network. Stronger relationships with agencies such as the FHWA, the U.S. Coast Guard, the Army Corp of Engineers, state regulatory/permitting agencies, and local governments have helped to bring about decisions more quickly. North Carolina's Merger 01 process built its foundation on the concept of concurrence, with all pertinent partners and stakeholders buying into project decisions at key milestones from the beginning. Utah's CMGC approach solicits the experience of independent contractors and begins collaborating with them as early as the design phase. These approaches have been found to expedite subsequent aspects of a project's design and construction, eliminating delays and interruptions frequently encountered when someone with decision-making authority "sees a project for the first time" at an advanced stage. When this occurs, the modifications required for such a person's approval are sometimes extensive, requiring re-work

after considerable time and budget have already been expended on the design. Time taken to communicate early in the project generally yields gains in owner and user buy-in, as well as in the overall schedule.

In every state, federal funding for transportation projects and programs are channeled through a continuing, cooperative, and comprehensive (3C) planning process administered by MPOs. These organizations consist of representatives from local governments and transportation authorities in metropolitan areas. A project does not receive federal funding if it is not in an MPO's Transportation Improvement Plan. Interviewed state DOTs have demonstrated a concerted effort to work with their MPOs and participate in a shared vision identifying needs and prioritizing projects at the MPO level. As DOTs are required to allocate increasingly scarce human, financial, and material resources to delivering their backlog of transportation projects, it is in a DOT's best interest to communicate and coordinate with the MPOs in their respective state.

The value of partnering with regulatory agencies and incorporating environmental streamlining and stewardship practices into project planning and design is realized in building trust between the agencies and yielding faster turnarounds in the review and approval process.

Team Approach (High-Performance Teams, Change Management)

The use of high-performance teams, specialized functional teams, or self-directed work teams supports the underlying finding that a team approach can lead to accelerated project delivery. Other types of teams such as change management teams and implementation teams have helped bring about successful transformations of an organization's structure and/or culture, resulting in system-wide improvements in program and project delivery schedules.

These successes cannot be realized without the concerted efforts of many individuals working together toward a common goal. State DOTs recognize that a supportive team environment drives project performance. Leadership and technical expertise are not sufficient to meet the missions and goals of a state transportation agency. This deficit, in part, has led to the development of unified team cultures to address today's demanding transportation issues. MaineDOT moved from a silo-based "assembly line" operation to a more inclusive team approach, accelerating programs through greater communication and clearer assignment of responsibilities. Teams have helped MaineDOT to establish real deadlines and achieve greater transparency and efficiency. This positive environment creates team spirit, cross-functional cooperation, and unified approaches so there is a greater tolerance for ambiguity, risk, and conflict, which give rise to innovations in behavior and approach.

Other types of teams are also instrumental in helping state DOTs achieve strategic goals. For instance, NCDOT's Interagency Leadership Team works to ensure that delivery strategies previously agreed upon are being implemented by different work groups and that these strategies are generating the desired goals. (*10*)

Creative Destruction and Realignment

The term "creative destruction," coined by economist Joseph Schumpeter in 1942, expresses an entity's or organization's need for constant re-invention with the idea that "out of destruction a new spirit of creativity arises." Used primarily in association with capitalism and free market competition, the concept of creative destruction can be applied to private and public organizations in the 21st Century when a transformation process takes place, accompanied by innovation. Economic progress occurs through rewarding individuals (or entities) that are innovative. The need to produce better quality services with limited resources and environmental constraints has compelled state DOTs to examine and make dramatic changes to their organizational structures in pursuit of innovative solutions and to empower employees with the freedom to unleash their creative potential.

NCDOT deliberately undertook a process of renewal and realignment in which it dismantled and de-layered many of the organizational silos that discouraged coordination among business units. Its new organization relies on performance-based, outcome-driven results and provides DOT-wide checks and balances. New Jersey DOT made a major cultural shift to a project management-based program and project delivery system. Even though there is no legislation requiring it to do so, Utah DOT is proactively moving to implement an environmental approval process for state-funded projects that is comparable to NEPA. This type of realignment disassembles the old processes so that new ones can be created. It requires huge shifts in institutional cultures and takes many years to implement even when it has been formalized.

These shifts in culture require strategic management of the changes that individuals must make in adapting to new and different ways of doing things. DOT personnel may have to adjust to a new way of thinking, modify a process, fine-tune the very activities they have been performing for years, and alter their behavior. Because change in general requires human effort, cultural shifts are difficult to bring about and require the support of upper management. State DOTs that have led the pack in bringing about unparalleled changes have taken many years (up to 10 in some cases) to realize these shifts in institutional culture.

To some extent, many state transportation agencies have undergone a form of creative destruction with their organizational structure and internal processes. Through this process, an organization voluntarily or involuntarily does away with

established procedures and methodologies to undergo a sort of renewal in which new programs and ideas are set up to replace the old. In a changing era of new technologies and knowledge-based management, state DOTs need to think constantly of how to optimize their assets and deliver quality results. In these paradoxical times, what is great today may only be mediocre or obsolete tomorrow. In the long term, organizations that create an environment in which creative destruction can occur grow richer and more productive as a result.

Organizational Profile/Structure

Which organizational structure better lends itself to efficient program and project delivery, centralized or decentralized? The answer does not lie in any one type of organizational structure, but rather in how vertical or horizontal the organization is. Tall, hierarchical silos are gradually being supplanted by flatter structures that afford more opportunity for communication and sharing of knowledge across management lines.

Organizational structure can be defined as the visible and invisible framework that connects and weaves all aspects of an organization's activities so that it functions as a complete dynamic entity. (*11*) An organization's structure affects its size, strategy, technology, environment, culture, innovation, and partnerships. The 21st century has seen a huge shift in the way organizations are structured. It is important to recognize that with the changing technological environment, organizations have to adapt quickly in order to be successful. State agencies are no exception to the rule. Classical structures organized around delivering size, role clarity, specialization, and control have transformed to deliver speed, flexibility, integration, and innovation. These design principles are evident in the state DOTs that were researched.

One premise of this research study was to identify whether an organization's centralized or decentralized structure fosters accelerated program and project delivery. Interestingly, centralization/decentralization was found to have little to do with the speed with which programs are delivered. What contributes more to accelerated delivery is how "flat" (horizontal) or "tall" (vertical) the structure is. State DOTs affirm that in order to respond quickly, perform critical functions, make decisions sooner than later, and provide services rapidly, more level organizations respond better to the overall goals of the DOT. The greatest advantage of a horizontal organization is the increased degree of lateral communication that occurs across units and management lines. The relative informality of a horizontal structure creates more opportunities for different units to collaborate, thereby building trust and moving toward the common goal of delivering a project. TxDOT restructured itself at the top level, where the executive director created a flat, non-traditional organizational structure. More than 40 individuals report to him, with only a single "layer"—the deputy executive director and two assistant directors—between him and the Department's many divisions, offices, and districts. (*12*) NCDOT likewise restructured from a tall pyramid to a flatter, wider configuration that required redefining key positions and functions. (*13*)

The complex environment in which transportation agency leaders are required to deliver aggressive programs requires an organization that is responsive to the needs of the public. State DOTs have found that non-linear, non-hierarchical, more holistic, self-organizing, flexible, diverse, and networked organizational models provide quicker program and project delivery. MoDOT's organizational structure is perhaps one of the most unique and modern arrangements. At the very top, it is led by a commission of six members—a chairman, a vice chairman, and four commissioners. No more than three of these may be of the same political party. Beneath the commission is a director of transportation who in turn leads a chief engineer and a chief financial officer (CFO). The chief engineer is responsible for the system delivery team (bridge, design, right-of-way, traffic, maintenance, etc.). But on the organizational chart, this system delivery team is pictured on a circular dial, removing any physical representation of hierarchy. The CFO is responsible for a system facilitation team, also represented on a dial. Below the commission are only three levels of hierarchy. This organizational structure allows for a fair and equal representation of the state's concerns. But from the highest level of authority, the message is clear that even from a political perspective, the organization will move forward providing equal representation and reduced hierarchical levels.

It is uncertain how state DOTs may restructure themselves in the near future. Few organizations are adept at constantly changing and adapting immediately to the shifting external environment. An organization consists of complex interactions between agents, in which cooperation and competition are key elements that shape the organization and drive it forward. In that composite environment, a complex, adaptive system may be required. One question that arises as organizations begin to make small changes is, does the shift truly occur as a second-order change, where individuals embrace the transformation? The goal of many transportation agencies may be to become an organization that supports dynamic, interactive work processes that help make effective decisions while supporting the overall mission and goals of the organization. Such a structure allows for a constant flow of information horizontally and vertically, thereby allowing employees' everyday responses and decisions to be guided by an overall sense of direction and purpose. (*11*)

Regionalization

States that comprise large geographic areas or experience a broad range of climatic conditions have found efficiencies in

regionalizing their district offices. Economies of scale and sharing of resources and information have resulted in better quality products and services. Regionalization allows for the flexibility of district offices to operate independently, while providing the support of a larger office when required.

Regionalization is not just common to large states with multiple districts. Certainly California and Texas, with 12 and 25 districts respectively, have nearly complete operating capabilities within each district to plan, design, and construct projects. District offices in many states are supported by central divisions and offices that help with policies, strategic management, programmatic guidance, and specialty design issues. The reasons for combining district offices into regions are numerous: to share technical expertise and resources; to enable environmental, topographic, and geographic similarities to be addressed uniquely; and to accomplish critical tasks at a quasi-centralized regional level so that skill sets are not unnecessarily duplicated in multiple districts.

Although New Jersey, the nation's fourth smallest state, has a centralized DOT, its DOT has three designated regions—North, Central, and South—each with distinct project concerns. Community cultures, urban fabric and landscapes, and political climates differ between these regions. Likewise, the 14 districts of North Carolina, a state that spans 500 miles from east to west with elevations ranging from sea level to 6,684 feet (the highest point east of the Mississippi), are grouped into three geographical regions—Mountains, Piedmont, and Coastal Plain.

State DOTs will continue to function either as centralized or decentralized structures. Neither configuration has been shown to be better than the other for accelerating programs and projects from concept to completion; however, regionalization can reap the benefits of each and holds some promise to deliver projects sooner.

Transparency

Transparency is a concept to which states are becoming more and more attuned. Transparency is about accountability: being responsible for decisions and actions, liable for persistent problems and unaddressed concerns, and answerable to the public for the way taxpayer dollars are spent. Closely tied with the adaptation of performance measures, the shift toward transparency is a natural by-product of developing and implementing performance measures and metrics. Transparency in an organization is realized when these measures are made available to the public. This frequently involves a shift in DOT culture as well.

During the course of interviews, some states expressed concerns about the image portrayed by their DOT or what the public's perception was. Even a slightly negative image or lack of trust can create roadblocks for managers and administrators trying to expedite programs and projects. Regardless of whether or not a project has full funding, the right design, and minimal obstacles to construction, it can be halted simply because the public feels uneasy about it. One way in which state DOTs have sought—successfully—to gain public support is by becoming more transparent. By allowing the public to view the DOT's efforts and have input in some of the decisions that are made, transportation agencies are building public trust and gaining the confidence of elected officials and their constituents.

NCDOT recounted its experience of becoming more transparent through the use of an online performance dashboard that allows the public to see its internal efficiencies. NCDOT intends to use performance measures as a promotional tool, to help package what it is already doing as an agency and showcase its progress to the public. From its perspective, the dashboard is a measure of how the North Carolina Secretary of Transportation's delivery measures up against the State Transportation Plan. California also recognizes that credibility is built by becoming more transparent. Upper management executives at Caltrans meet with local officials and legislative representatives on a quarterly basis to keep them up to date on transportation issues. After four consecutive years of delivering 100 percent of the projects on their "Ready to Let" list, Caltrans has gained a great deal of political and public support. This transparency also translates to greater trust and integrity. As Caltrans continues to experiment with innovative, out-of-the-box approaches to project delivery, congestion management, and construction, the public is willing to be more accommodating on account of Caltrans' proven track record. Missouri's *Tracker* proclaims to the public that "this document is your window to MoDOT–warts and all. It invites you to hold us accountable for exceeding your expectation." (*14*)

It is anticipated that as more states begin to develop performance measures and incorporate them in their transportation services, they will opt to provide a window for government officials, stakeholders, and the public to see how they are doing. The intentional use of measures and goals, whether for decision-making, planning, tracking, or management processes, will provide reporting information of significant value. The extent to which state DOTs display or provide this information to the external community in a meaningful, user-friendly manner will determine their level of transparency. At least in this sector of government, transparency is on the rise.

Challenges

The Perfect Storm

State DOTs are currently experiencing a "perfect storm." Given their aging infrastructure, financial limitations, increasing congestion, system size and complexity, and increasing

population, transportation agencies face demanding and difficult times. They need to look for better ways of doing business and accomplishing more with fewer resources.

There has rarely been a time when a combination of factors has created such challenging circumstances for transportation agencies. Most states have portions of highway infrastructure that are more than 50 years old. Almost 25 percent of the highway bridges in the United States are more than 50 years old and are structurally deficient or functionally obsolete. (*15*) For example, the Memorial Bridge carrying U.S. Route 1 from Kittery, Maine, to Portsmouth, New Hampshire, is 86 years old, and the Waldo–Hancock Bridge in Bangor is 74 years old. It is safe to say that much of the nation's infrastructure has outlived its life cycle and is now in need of repair and rehabilitation—or outright replacement. In light of this, some state DOTs have shifted priorities to catching up on maintenance and rehabilitation projects, placing new capital projects on hold.

States are also facing difficult economic times. Increases in transportation funding have not kept up with increases in the cost of materials and labor for new capital projects. While some DOTs are looking at innovative ways of increasing their revenue streams (e.g., tolls, public–private partnerships, etc.), others have perilously extended themselves, borrowing against the future. States must find ways to stretch their transportation dollars further so that the investments they make today will have lasting benefits.

The size and complexity of a state's roadway network must be factored into how DOT leaders shape the transportation system under their jurisdiction. Some DOTs are responsible for operating and maintaining a large share of their state's highways and multimodal facilities. Other state DOTs in charge of smaller systems still have the challenge of maintaining an aging, often complex infrastructure built over different topographic features and time periods, using a variety of technologies and materials.

The problem of increasing congestion that is ubiquitous on the nation's highways places a strain on the infrastructure as well as the patience of drivers. Congestion statistics are staggering, and its effects are most felt in large urban areas where motorists waste time and fuel stuck in traffic. This issue is not easily resolved. States with a high proportion of urbanized area cannot easily build new roads or widen the existing ones to accommodate the ever-increasing traffic volumes. Even in states that are predominantly rural, pockets of congestion still exist where capacity is insufficient. An inadequate transportation system, with its attendant congestion, compromises the economic prosperity of a region, state, or nation. State DOTs are finding innovative ways to provide connectivity to their vital economic generators, but the solutions are more complicated, and even more challenging to implement, than simply building new roads or widening existing ones. The option to "build our way out of congestion" does not exist anymore.

Demographic transitions occurring throughout the United States and the overall increase in population, largely due to migration, places more drivers on America's roads. Aging populations, including the maturation of the still very active baby boomers, influence travel patterns and continue to demand more and better mobility options. Travel demand has outpaced population growth due to increasing average trip lengths, and travel behaviors have changed due to differences in work and leisure trips, specialization of labor, and redistribution of people and jobs. (*16*) This combination of factors creates the "perfect storm" scenario within which transportation agencies must work to find unique solutions for the mobility needs of tomorrow.

Outsourcing Pre-Construction vs. Keeping It in House

There is a great diversity among the researched states in exercising the option to outsource planning and design of projects vs. keeping the work in house. Some state DOTs have managed to retain their staffing levels from year to year and meet their annual program delivery goals. Other states have undergone significant attrition and have resorted to routinely procuring professional services consultants as a means of helping them deliver their programs. The challenge is in finding the most cost-effective balance between what and how much to outsource.

The following list shows the percentage of pre-construction work outsourced by the state DOTs that were researched:

- California: 10 percent
- Maine: 30 percent
- Maryland: 30 percent
- Missouri: 50 percent
- New Jersey: 80 percent
- North Carolina: 30 percent
- Texas: 60 to 70 percent
- Utah: 60 to 70 percent

DOTs that have maintained their workforces still have the capabilities to perform most of the work in house. However, that is not to say that there is a correlation between a large work force and the amount of work kept in house. Some states such as Texas outsource a large percentage of their work in order to deliver a large annual program. New Jersey DOT, nearly halved through early retirement programs, has been left with a smaller work force. Hence, New Jersey has one of the highest percentages of projects outsourced to private consultants. Because of the broad range of factors involved, it was not possible to establish a correlation in this study between the proportion of work outsourced and the resulting ability of a state DOT to accelerate a project or program.

Procurement strategies are being modified and implemented so that consultant services can be maintained throughout the life of the project, from conception to completion. The number of multiple procurements on a project—multiple requests for proposals (RFPs) from the agency and multiple proposals from the consultants—can be reduced by accelerating the overall project development process through task orders. TxDOT hires one consultant for select projects to do everything from conception to completion through the use of CDAs. New Jersey DOT has begun procuring consultant services using the same consultant to take a project from the beginning to the end—scoping and concept development through final design. Such agreements reduce the ramp-up efforts and the time it takes for a new consultant to become familiarized with a project. From the state's perspective, two to three months can be lost every time a new consultant has to be procured for the same project. From the consultant's perspective, non-billable time spent responding to RFPs can be reduced if the entire job is awarded through a single selection process.

Right-of-Way/Utilities/Railroads

Perhaps the most difficult phases to accelerate in any project are ROW acquisition and utility relocation. For various reasons, there is no uniform procedure established across the states when ROW and utility issues hold back project delivery. Each state DOT must deal with different municipal and regional telephone, electric, gas, and cable TV companies, in addition to local water and sewer authorities. Northern city centers often have central heating plants that deliver high-pressure steam to numerous large buildings via underground pipelines. Technology centers tie into local suppliers of nitrogen gas for their clean-room environments, again delivered through underground lines. Very often, each of these utility companies or authorities has their own set of procedures for dealing with highway projects. Railroads present an additional set of roadblocks that frequently complicate and delay project delivery.

Projects that involve ROW acquisition pose challenges for transportation professionals. Eminent domain takings are the most likely activity to cause delays because the litigation process is so long. But ROW acquisition procedures vary from state to state. Utah uses many methods to keep projects on track, including passing more of the control and the risk to the contractor. However, UDOT has one of the quickest ROW acquisition processes: when a property goes to litigation, it is typically resolved in approximately nine months; meanwhile the use of a "right of entry" allows construction activities to take place in parallel with the negotiation process.

TxDOT employs possession and use agreements, beginning construction on a property by paying the owner the appraised value of the property up front, while the ROW acquisition process is just beginning to move forward.

Utility issues remain a challenge when it comes to relocation of both above-ground and subsurface features. Even with advance notification, planning, and communication, a utility company's priorities will differ from the state's. Utility companies must deal with their own limited resources and in many cases have seasonal constraints on both doing outdoor/underground work and temporarily shutting down service. Franchise or reimbursement agreements, where the state pays for the cost of the relocation, help expedite the situation, but many partnering sessions are required to bring the utility companies on board with a project as early as the design phase.

Railroads appear to pose some of the greatest challenges to project delivery. States and railroad companies invariably differ on the valuation of property that may need to be acquired. Their priorities seem to conflict at every turn; each sees the other as a necessary evil to be dealt with. One participant interviewed for this project noted, "The number one thing I don't want in my project is a railroad!"

Right-of-way, utilities, and railroads continue to challenge highway departments when it comes to program and project delivery. Alliance agreements, incentivized utility relocations, and appraisal sharing may be innovative approaches to expedite projects fraught with utility and ROW issues. (*17*)

Baselines and Targets

One of the greatest challenges for states that are moving toward developing and implementing performance measures is the gap in available data—or the complete lack of data—for setting baselines. Without baselines, progress cannot be evaluated; targets cannot be set. More discouraging is the fact that states may not have the technology, resources, or funding to collect the complex data required for input into a meaningful metric.

All state DOTs have traffic data available to them, but if the data does not provide intelligence, it does nothing to help senior managers make the right decisions. States that have begun their journey toward implementing performance measures are finding that determining baselines for the measures they selected is not an easy task. New Jersey DOT struggles with the tools and techniques currently available because the information generated from its measurement systems (e.g., bridge inspection and pavement condition reports, crash data) are not mature enough to perform sophisticated analyses. Thus the quality of the final product or service is only as good as the quality of information introduced into the equation. Setting an accurate baseline is important because it is then used as an evaluative tool for continuous improvements. Once the baselines are determined, goals or targets could be set.

When state DOTs were asked what was the average number of months (or years) that a project took to go from conception

to completion, the responses were vague. Data is simply not collected for this beginning-to-end measure. However, sufficient information often does exist for selected phases of a project. For instance, UDOT's average environmental process for a new alignment takes approximately twelve months and ROW acquisition takes no more than nine months.

Perhaps what complicates the attempt for states to set baselines and identify targets is the size and variety of projects included in a given program for delivery. Capital improvement "mega-projects" and very small maintenance projects may be managed simultaneously. This mix of large and small budgets, highway and bridge projects, stormwater management and utility issues do not share common bases upon which they can be measured side by side. More research is required in this area.

Context-Sensitive Solutions

For most states, the context-sensitive solutions process (CSS) has become an integral step in development and execution of a project. In the socio-cultural context, it significantly reduces the barriers of public opposition; however, from a pure engineering aspect, it may create scope creep and cause a project to diverge from the original purpose and need. While CSS is critical in expediting some projects, it is equally responsible for introducing delays to project design and public outreach.

States interviewed expressed mixed feelings about CSS as it relates to accelerating projects from conception to completion. In cases where public opposition was resolved when CSS was implemented during the planning stages of a project, CSS was perceived as a necessary step to accelerating the project. Some states, however, claimed that CSS involves additional funds and time to incorporate appropriately and successfully and still does not achieve the expected results of a general consensus between stakeholder and the state. Maryland's DOT has fully incorporated CSS into its standard operating procedure. While it recognizes that CSS requires additional time and an element of risk, true partnering occurs over time, and stakeholder involvement from the beginning and often through the planning phases generates a mutual understanding and balanced solutions. UDOT also incorporates CSS philosophy into its overall strategic direction. Through CSS awareness training and collaborative multidisciplinary teams, CSS is fully integrated in the way they work. Senior management's view is that "Context-Sensitive Solutions is more than an initiative. It is a fundamental change in the way we do business. As each of us comes to understand the elements of CSS, it will be woven into the way we do our work, and it will become an integral part of the UDOT culture." (*18*)

In 2005 MoDOT took a step back from CSS to look at the bigger picture and introduced the concept of practical design by declaring that "state DOTs must deliver the transportation system better, faster, and cheaper than ever before. MoDOT's Practical Design effort accomplishes that goal by building 'good' projects everywhere instead of 'perfect' projects somewhere." (*19*)

Practical design has involved a commitment to focus on adequately meeting the purpose and need without unnecessarily going beyond, getting the best value for the least cost, never compromising on safety, and collaborating on the solution. An interviewee from MoDOT stated, "We focus on meeting needs, not a wish list. . . . We build partnerships based on needs, not demands."

Perhaps the best approach to incorporating CSS into programs and projects is to be aware that it yields diminishing returns: Applying it judiciously at the front end of a project may indeed expedite it; however, seeking continuous input from all stakeholders as the project proceeds will result in delay and confusion.

Most states understood that CSS requires a flexible approach in design standards to fit the project into its surroundings. The biggest challenge encountered is that stakeholders tend to demand more than what has been budgeted for. The resulting impasses create distrust and unwillingness on the part of the public to cooperate with the state. One interviewed employee voiced MoDOT's solution: "Never do visioning with the stakeholders without having a stated budget at the beginning of your outreach." Some DOTs are guided by a state policy to incorporate CSS principles into the planning and design of their major projects. As of 2004, 26 states had adopted such policies into their framework. (*20*)

Policy

Case studies have shown that state and federal environmental regulations and funding issues are often perceived to conflict with existing transportation policies. Some environmental streamlining has been accomplished through federal policy changes, but it is a complex arena and only a few states have an environmental policy that matches or exceeds federal NEPA requirements. In fact, many practice streamlining more informally by building strong relationships with state and federal review agencies. Limited revenues in today's environment also challenge existing funding policies. New sources of funding, new propositions, and innovative funding agreements may be on the horizon for some states. But most states are looking for ways to stretch every penny of every tax dollar.

State DOTs and the FHWA have made significant efforts over the past five to seven years to achieve both environmental streamlining and environmental stewardship. A track record of environmental stewardship builds trust and public support, smoothing the way for future projects. Most states have moved beyond environmental avoidance and environmental mitigation, to environmental enhancement—projects that leave the environment "better than before."

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) authorized three types of delegations of the FHWA's environmental role: Categorical Exclusion (CE) projects, a five-state pilot delegation for NEPA and other laws, and a five-state pilot delegation for Recreational Trails and Transportation Enhancements projects. Utah, one of the states studied for this project, is a pilot state in the NEPA delegation program. This program, combined with its very low (15 percent) dependence on federal transportation funds, has enabled UDOT to move forward on many of its projects without requiring FHWA approval.

Inferences Drawn from Trends and Challenges

A transition is under way, from an era of new builds and high-profile capital projects with unlimited funding to an era characterized predominantly by projects that rebuild, maintain, and repair under limited funding options. Despite this radical shift, transportation agencies must still keep pace with the transportation demands of the present decade, while planning for future growth. The trends and challenges noted here are intended to provide transportation decision makers with a starting point, an introductory map, to gauge how well their organizations operate within their existing framework. Trends can be seen as successful elements, factors that contribute to a state's ability to accelerate program and project delivery. Infused throughout these trends are the challenges that must be addressed through iterative, relationship-based approaches, creative funding opportunities, flexible design options, and exemplary management strategies. By carefully evaluating the potential benefit offered by each trend, and soberly gauging the extent to which the challenges are mirrored in their organization, leaders of state transportation agencies should be able to build on their existing strengths and increase their ability to further their agencies' stated missions and goals.

CHAPTER 5

Best Practices—Case Study Reports

Case studies on the eight selected state DOTs are presented in this chapter.

These case studies are not intended to provide a means of comparing and contrasting state practices, but rather a forum to showcase and highlight their strengths in program and project delivery within the context of their environment.

California

Performance-Based, Outcome-Driven Results for Program Delivery

The California Department of Transportation (Caltrans) has always strived for a collective vision that provides "for the mobility and accessibility of people, goods, services, and information through an integrated, multimodal network." The goal is to achieve a fully integrated, multimodal, sustainable transportation system that supports three outcomes that define quality of life—prosperous economy, quality environment, and social equity (*21*).

California's state highway system consists of approximately 170,000 miles of public roadways, of which Caltrans operates and maintains 15,269 miles (*22*). While less than nine percent of the State's roads fall within Caltrans' responsibility, this transportation system supports the sixth largest economy in the world due to its rich farmlands, diverse industries, and motion picture production enterprises. The Golden State is 158,693 square miles from top to bottom and faces a tremendous challenge in providing for the growing population (*23*).

With 36 million people, California is the most populous state in the country (*24*). The population is projected to grow to approximately 48.6 million by the year 2025, which represents a 35 percent increase (*25*). This growth is expected to occur in urban areas, with increasing elderly and Hispanic populations. Apart from these changing demographics, travel behavior, social trends, and land use changes place a clear demand on the existing infrastructure.

A closer look at Caltrans' roads reveals that 10,821 miles are rural while only 4,413 miles are urban. The rural areas of California have only eight percent of the population but compose ninety-four percent of the land area. Forty-six percent of the state's roads are located in rural areas. Caltrans recognizes that rural issues have different characteristics than urban areas and providing transportation to the remote rural locations is a challenge. The sparse population may require special transportation needs when planning and designing for a completely integrated, interconnected system. Furthermore, California's economy relies heavily on moving agricultural products, timber, and tourists through its rural regions via roads, bridges, and rail systems. Issues that affect rural areas vary depending upon an area's economic base, topography, and proximity to urban areas. Part of the concern is that if a rural area is located adjacent to an urban area, a "spillover" of big city problems occurs. For instance, the rural area may experience traffic and air pollution, but not have the funds or resources to address these problems (*26*).

California's Economy and Goods Movement

Because of California's location on the Pacific Coast, it has the unique advantage of being a cornerstone in the shipping and receiving of goods via its many ports. This in turn provides opportunities for other industries and commerce to benefit from California's unique location. California's own strength in being the largest agricultural and food producer in the nation, with almost $25 billion per year in agricultural output, makes truck access of particular importance. Timber, food, and agricultural industries rely heavily on the trucking industry and the existing transportation system to move and distribute products not only within California but to other states as well. The large trucks take a huge toll on the local and state roads that connect to the interstate system. Pavement conditions, along with other factors such as noise, air quality, and safety, are especially impacted by truck traffic.

VMT on California's roads is 328 billion annually (*22*). Beyond the wear and tear of daily vehicles on California's pavement, the climate imposes an entire set of extreme circumstances which the transportation system must bear. Cold-weather freeze–thaw cycles in the north and high-elevation areas, extreme heat conditions near the deserts, earthquakes, and forest fires all have a direct impact on motorists in their daily commute. Such a great challenge calls for innovative solutions as California advances and prepares for the next two decades of change.

Funding for transportation in California comes from a variety of sources such as state, local, private, and federal funds. State funds consist primarily of the state excise tax on gasoline and diesel fuels and truck weight fees. Federal funds consist mainly of the federal gasoline and diesel fuel excise taxes. Local funding sources include local sales tax measures, a small percentage share of the state general sales tax, and local general funds (*27*).

The current transportation budget allocates $13.7 billion in expenditures for Caltrans. The 2008–09 budget provides approximately $6.2 billion for transportation capital outlay, $2.7 billion for local assistance, $1.8 billion for capital outlay support, and about $1.4 billion for highway operations and maintenance. The budget also provides $397 million for Caltrans' mass transportation and rail program and $890 million for transportation planning and department administration. The balance of funding goes for program development, legal services, and other purposes (*28*). However, it is estimated that California's unfunded transportation needs are $160 billion.

An assessment of California's transportation trends reveals that infrastructure investments have not kept up with the increase in population or the VMT for both work-related commutes and non-work–related travel. According to the FHWA, almost half of California's urban highways are congested. This fraction is 65 percent greater than the national average. It is expected that on-road VMT will increase to 475 billion by the year 2020. This is a 55 percent increase from the year 2000 (*26*). Additionally, according to the 2007 Annual Mobility Report, Los Angeles ranks as the number one city in the entire nation for travel delay, excess fuel consumed, and congestion cost (*29*).

Caltrans progressively implements new strategies to achieve their goals to realize their vision of a transportation system that provides safety, mobility, and improved quality of life.

Organizational Structure

Caltrans has a strong work force of about 22,000 employees. The director, along with the chief deputy director, is responsible for nine key programs and 12 districts. The key programs include Project Delivery, Maintenance and Operations, Planning and Modal Programs, Administrative and Information Technology, and Finance. Each of these programs has deputy directors who are responsible for managing numerous smaller divisions. For example, Project Delivery has Construction, Design, Engineering Services, Environmental Analysis, Project Management, and Right-of-Way and Land Surveys Divisions under its umbrella. The 12 district directors also report to the director.

Caltrans' organizational structure is predominantly decentralized for project delivery because the state is so large and varies greatly in topography, climate, and socio-cultural issues as one moves from north to south. Urban and rural settings impact both design and project delivery paths. Design issues vary from district to district, as do the cultural groups and communities, and each must be dealt with individually. In areas where there are large numbers of ethnic or native communities and/or dense urban populations, an intensive public outreach effort may be required. For rural settings or extreme climate conditions, design parameters may pose a constraint for construction and ultimately project delivery. As such, the districts and their project delivery staff provide specialized expertise in understanding the environment, the social fabric, design constraints, topographic challenges, climate-related issues, and the political arena within which a project must be designed and delivered.

Some districts are clustered and form consolidated regions for project delivery. For instance, the Central region includes four districts that share a project delivery staff. This consolidation allows for greater efficiency and a regional approach to project delivery. As one deputy director noted, "We are decentralized [districts] into centralized regions" (*30*).

Internal Reorganization

Caltrans does not claim to be an organization that is structured solely for the purpose of delivering projects. But the organization has changed in the last decade so that greater efficiencies are realized through more streamlined processes. An organization that allows for better communication among its units and greater collaboration helps to achieve a higher quality product and quicker response times.

A gradual reorganization at Caltrans has occurred, more for reasons of practicality. For instance, the Environmental Analysis Division that used to be part of Planning and Modal Programs was moved into Project Delivery. Also, local programs were separated out of the Design Division.

Moving the development of project initiation documents (PIDs) out of Project Delivery and putting them in the Planning and Modal Programs was another organizational change. A PID is one of the first steps that define a project before it gets programmed. Like a mini-project report, it includes the project planning, scoping, and programming. It provides a "clean start" to the project, as noted by one division chief.

Caltrans' capital program has grown significantly over the last five years. Their staffing levels, however, have not increased to respond to the growing programs. Caltrans has maintained relatively the same number of employees over the last 10 years. While other states have markedly reduced their numbers in response to reduced budgets, Caltrans remains steady in employment numbers. But Caltrans differs by a large margin when the level of outsourcing is compared. Similar large- and mid-sized states such as Texas and Florida outsource up to 70 percent and 80 percent of their workloads, respectively. Caltrans only outsources 10 percent of its work and often only by function (e.g., construction inspection, environmental investigation/documentation, etc.) rather than entire projects (*12*). Yet, under such a great demand to engineer complex projects and continuously meet the quota of delivering the capital program, how does Caltrans mange to "crawl through the barbed wire," meeting the goal of delivering 100 percent of the Ready to Let projects? The answer lies in three key areas where Caltrans excels at accelerating projects from conception to completion: (a) project management strategy, (b) NEPA delegation, and most important (c) performance measures.

Project Management Strategy

According to some Caltrans managers, the organizational structure may appear "stove-piped" and does not show the strong, deliberate efforts toward developing a project management strategy over the last 10 years. Caltrans has many project management policies and procedures that emphasize project delivery from the start. The move toward a project management approach began in the middle to late 1980s but was formalized in the early 1990s. However, the objective of having a project managed in an organized manner from its inception to its completion was documented as early as 1976, as evidenced by the following note, "Develop Project Management Control System (PMCS), a computerized system for managing and controlling highway projects of all sizes from the earliest planning phase to the completion of contract, data in PMCS stored by project." While in the 1970s the challenge may have been to leap into the computerized era, the approach toward a project management strategy that allowed for "managing and controlling" projects was just as important. (*31*)

A review of Caltrans' chronology of events discloses that much effort was spent in developing the project management philosophy from 1980 to 1989. A Project Management Implementation Plan was developed and approved, and formal training was provided, on core concepts of project management. Still, comments provided by the Transportation Commission Assembly noted that "Caltrans should look to other organizations for new project management techniques to reduce project development and delivery lag times" (*32*).

During the 1990s project management strategies were further developed through task forces, external peer reviews, project management re-engineering teams, training academies, and reorganization plans that steered the focus of project chiefs on project delivery rather than functional activities. Five strategies were outlined in a 1994 Director's memo:

1. To fundamentally transform Caltrans from what it was to what it must be in order to serve the already changed needs of the people and business of California;
2. To organize and manage by business process;
3. To reinforce and facilitate delegation of authority and responsibility to the lowest practical level, and also to build in the mechanisms for accountability and assistance to ensure top performance;
4. To reduce the cost of doing business while maintaining quality; and
5. To focus on the customer—the people of California.

This was a call for "Meeting the Challenge to Change" (*32*). By the end of that year, Caltrans had already begun its transformation into an organization that could deliver projects more efficiently.

Risk Management

Many states perform a risk assessment at some phase of the project. Stakeholders, project sponsors, and DOTs need some assurance that the project is constructible, can meet the needs for which it was intended, and can be built within the allocated budget and a reasonable time frame. Risk management is an integral part of project management, yet Caltrans only adopted a risk management strategy for project delivery since March 2004.

Caltrans provides a risk management handbook for all project managers. Large, complex projects benefit the most from a risk management plan that identifies and quantifies all the potential risks and ways to mitigate or exploit them. Successful project risk management requires a corporate culture that supports an open, honest, and realistic recognition of project risks and discussions of risk in an environment where there is no enforcement of bureaucratic hierarchy. Identifying risks requires the judgment and expertise of informed individuals. However, risk management takes time and most project budgets don't allow for a formal risk management plan.

At Caltrans, risk management is performed on every project either through informal discussions or via a formal risk register. Project Delivery headquarters in Sacramento encourages all districts and regions to actively incorporate risk management principles into project delivery and provide support for implementation of the risk management plan. In every case, project managers are left to decide the level of risk assess-

ment that is required for a project. Typically, smaller, simpler projects with very few community concerns may not even have a risk management plan. Complex, large projects carry greater risk and a project manager may decide to have a full risk management plan to manage crises and unforeseen events. In such cases the risk management plan is implemented early on and monitored throughout the life of the project. The end result is that project managers and sponsors can make informed decisions regarding alternative approaches to achieving their objectives.

NEPA Delegation—Balancing Delivery with Stewardship

Under the SAFETEA-LU bill that became law in August 2005, Caltrans now has the ability to streamline the federal environmental review process. It became the first of five state transportation agencies to participate in the federal Surface Transportation Project Delivery Pilot Program or NEPA Delegation. Under the pilot program, the FHWA assigned to Caltrans the U.S. Secretary of Transportation's responsibilities for federal approvals under NEPA and other federal environmental laws such as the Endangered Species Act and Section 106 of the National Historic Preservation Act (*23*).

Section 6004 and 6005 of the law allows Caltrans the opportunity to test and streamline the environmental process. As of July 1, 2007, Caltrans assumed the FHWA environmental responsibilities under NEPA. This assignment includes all projects on the State Highway System and all local assistance projects off of the State Highway System within California. FHWA responsibilities include environmental coordination and consultation under the federal environmental laws pertaining to the review or approval of projects under the pilot program (*33*).

The goal for Caltrans is to simplify and expedite the project delivery process. The NEPA process involves a strict adherence to the standards that protect the environment. The California Environmental Quality Act (CEQA), passed in 1970 on the heels of NEPA, imposes some requirements that are more stringent than the federal ones. For this reason, Caltrans was well positioned to become a leader in expediting the environmental review processes.

The pilot program does not change federal environmental protection standards. Caltrans' participation in the program shows California's continued leadership in environmental protection and transportation project delivery. Implementation of the pilot program was expected to simplify and expedite the federal environmental review process for transportation projects, while ensuring the same level of protection for environmental resources. The program has some proven results and has benefited Caltrans with an overall time savings and quicker delivery for producing approved environmental documents. Since the program started, "Caltrans has decreased the amount of time required for environmental document approvals. Draft review went from more than six months, to less than two months. That's a time savings of 69 percent on draft review and 68 percent for final document review (from 2.5 months to less than a month). These savings were achieved after eliminating FHWA environmental document review and working directly with federal resource agencies to meet their requirements" (*23*).

Best Practices for California

Performance Measures

For a number of reasons, many state DOTs are becoming more focused on developing performance measures. Performance measures allow for an inventory of the existing transportation system, address system conditions, communicate priorities to the public, help make informed decisions, and promote change. It is an evolving area that addresses many factors and provides numerous benefits. But for a state to develop, experiment, and constantly refine the process takes many years and assertive determination to continuously want and expect more. Caltrans has managed to incorporate performance measures into every aspect of delivering a project.

The concept of a performance-based management program is interlaced with every aspect of the way Caltrans does business. It includes all levels of management and decision making, from the transportation commission to the director to division managers all the way down to line employees. It incorporates the strategic plan, the operations plan, and the actual performance measures. The extent of Caltrans' holistic approach to project delivery can be appreciated only by understanding the agencies involved, Caltrans' move toward transparency, the level of commitment by Caltrans' managers, and the paradigm shift that has occurred since performance-based management was implemented.

Transportation Policy Players

California transportation policy involves federal, state, regional, and local entities. At the federal level, the U.S.DOT, the FHWA, and Federal Transit Administration (FTA) are involved. At the state level, the California Legislature, Caltrans, the California High-Speed Rail Authority (HSRA), and the California Transportation Commission (CTC) are involved. The state has 26 Regional Transportation Planning Agencies (RTPAs) that administer funds, allocate federal and local funds, and select projects for improvement at a regional level. Finally, the state's 18 MPOs are very involved with the planning and prioritizing of projects that are included in the Regional Transportation Plan. They plan and program projects in urbanized areas with populations over 50,000. Local

involvement includes cities, counties, and transit agencies such as Bay Area Rapid Transit and the Los Angeles County Metropolitan Transportation Authority (*27*).

The RTPAs have an integral role in which capacity projects are prioritized for design and construction within their purview. For instance, in the Bay area, the Metropolitan Transportation Commission (MTC) actually selects the projects and hands them over to the engineering firm, which may be Caltrans, for concept development, design, permitting, and construction.

Complete System Approach

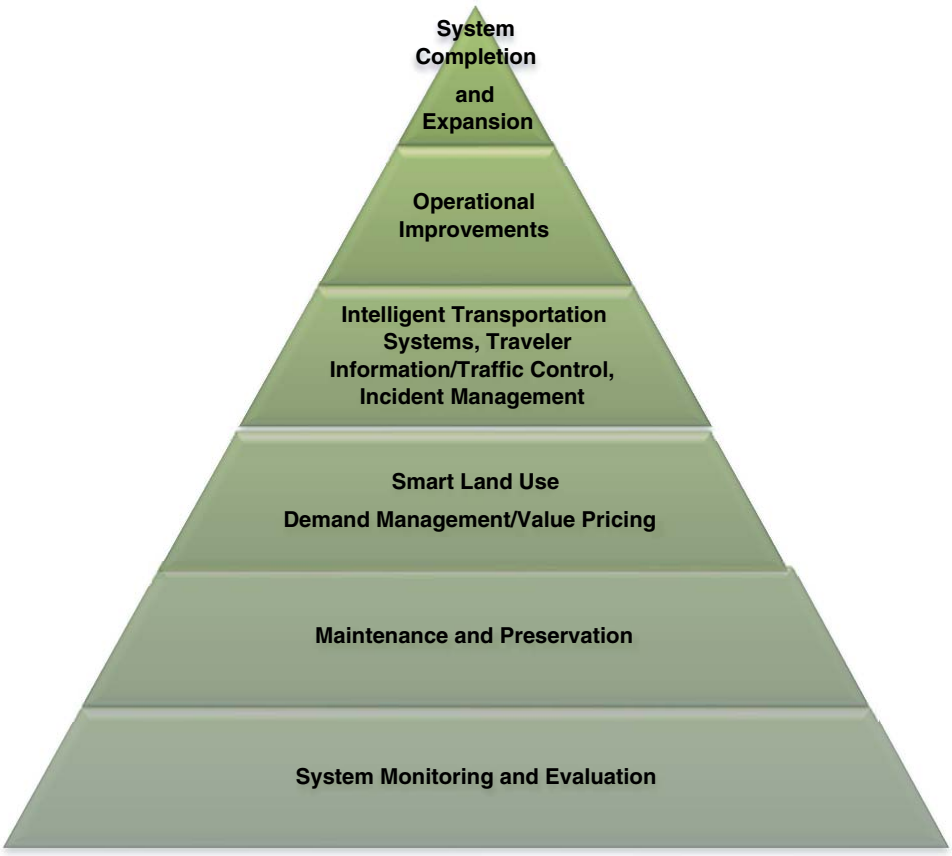
Caltrans has built a pyramid upon which transportation investments lead to significant improvements (Figure 3). It is a performance-based, outcome-driven approach that can be applied to many transportation issues. For example, the strategies outlined in Figure 3 can be used to reduce congestion. System monitoring and evaluation, and maintenance and preservation form the foundations upon which other strategies are built. Operational improvements and system completion and expansion will provide the mobility benefits over the next decade (*34*).

State Transportation Improvement Program, State Highway Operation and Protection Program, and Traffic Congestion Relief Program

Three components make up Caltrans' programs: the State Transportation Improvement Program, the State Highway Operation and Protection Program (SHOPP), and the Traffic Congestion Relief Program (TCRP). Funding is administered by the CTC.

The State Transportation Improvement Program is a five-year capital improvement plan that is updated every two years for transportation projects throughout the state. These projects add capacity to the transportation system; funding dollars are distributed using a formula to regions and inter-regional areas.

The SHOPP is a four-year capital improvement plan that is also updated every two years. This plan specifies projects that provide rehabilitation, maintenance, and operational improvements, including safety. Initially, the SHOPP begins with a 10-year plan that contains a list of projects based on need. This list is eventually pared down to a funded list of projects which is finalized to become the four-year SHOPP plan. SHOPP projects have priority over the transportation dollars and projects are funded based on a statewide need



Source: California Department of Transportation

Figure 3. Complete system approach.

rather than a geographic formula. Funding for SHOPP comes "off the top" of the State Highway Account.

The TCRP is also referred to as Proposition 42. Proposition 42 is funded separately from the State Transportation Improvement Program. It amends the state constitution and allows for a permanent dedication of the sales tax on motor vehicle fuels to be allocated to transportation (*27*).

Toward Transparency—Changing the Political Mindset

Caltrans has set a clear direction for its future. The 2007–2012 Strategic Plan highlights the goals and directions that the organization wants to take. Each goal reflects an area of improvement and is tied directly into performance across the organization. This is an incredible attempt to bring so many diverse operations, processes, programs and policies together to align toward a common vision. Caltrans identified five goals (*34*):

- Safety—Provide the safest transportation system in the nation for users and workers.
- Mobility—Maximize transportation system performance and accessibility.
- Delivery—Efficiently deliver quality transportation projects and services.
- Stewardship—Preserve and enhance California's resources and assets.
- Service—Promote quality service through an excellent workforce.

Caltrans' third goal emphasizes its constant efforts to deliver quality transportation projects and services efficiently so that it can become transparent, i.e., accountable, to the user.

Moving toward transparency has not always been easy because changing the political mindset was necessary. The public has not always understood the complexities of constructing a project, let alone having multiple stages of a project that won't come together until it becomes a finished, usable product. Nor have the political constituents always been privy to the difficult project prioritization process that must occur annually. However, the leadership of a very engaging director has allowed Caltrans to change the mindset of the public. It started with performance measures and delivering on promises made. The goal has been set at 100 percent delivery for projects on the Ready to Let list. After small gains, Caltrans has achieved a high success rate in the last four years (*23*):

- FY 2001–02: 86 percent
- FY 2002–03: 85 percent
- FY 2003–04: 87 percent
- FY 2004–05: 96 percent
- FY 2005–06: 99 percent
- FY 2006–07: 100 percent
- FY 2007–08: 100 percent

As shown in the preceding list, once again, for the FY 2007–2008 transportation program, Caltrans delivered 100 percent of the 294 projects on the list (a total worth of $3.5 billion) (*34, 23*).

This delivery translates to credibility and integrity in the eyes of the public and their political leaders. In the political realm, credibility is critical. It takes a long time to build it, but it can be lost instantly if inaccurate information is presented. The integrity of performance measures are key for an agency, because they provide internal guidance to ensure that the agency is providing the optimum service for every tax dollar collected.

Performance-Based, Outcome-Driven Results

How does Caltrans accelerate the delivery of its projects consistently and efficiently? In the early 1990s, Caltrans began with a system vision: "all forms of transportation in a unified, interconnected manner." There was also a "call for better management with an eye on performance" (*34*). Due to an Executive Order, California's 1993 transportation plan alludes to the development of appropriate transportation system performance objectives and measures. California's system at that time was a set of interconnected parts that lacked a standard management function to help understand the existing conditions and accomplishments and carve future targets. Caltrans needed a planning tool to improve investment analysis while delivering a customer-oriented, as opposed to a service provider-driven, program.

A workshop held in Sacramento in 1997 served as the starting point for the entire performance measure approach to be examined, for eventual development into the performance management system that is in place today. Some of the key themes discussed at the workshop formed the foundation of how performance measures would be developed, used, and monitored. One key point raised was whether performance measures should be based on outcome or output. While output-based measures relate to the agency's accomplishments (number of lane-miles added, improvements in level of service, etc.), outcome-based measures track the extent that the users of the system achieve their goals. Tracking mobility, reliability, and accessibility, for example, are ways of measuring outcome. However, outcome-based measures are difficult to devise and time consuming to document. These measures have to be relevant and useful, so that users can understand them and link them to the investment of their tax dollars in the transportation system.

Another key point is that performance measures should be decision tools, not decision rules. Performance measures do not replace politics, but rather "reassert a balance between political decision making and scientific and technical knowledge" (*35*). They should help make better decisions overall, so that funding can be allocated appropriately and weaknesses in the transportation delivery system can be addressed so that the system can improve holistically.

The dynamic process of implementing performance measures successfully requires political buy-in. Political powers and stakeholders are important opinion leaders, and they should be involved in the process of developing indicators as well as participating in the entire process of developing and implementing performance measures. An inclusive and participatory approach is essential to gaining political acceptance (*35*).

Users and customers also had to be included in the process in order for it to be responsive to their needs. User expectations vary with respect to mode, location of activities, pattern of travel, and length of trips. Performance measures would therefore have to be sophisticated enough to account for this user variability and be capable of collecting and processing diverse information. Moreover, "there is an important link between the measurement of system performance, users' satisfaction with the performance of the system, and the policy planning and funding process. Improvements in infrastructure can only be attained if the funding priorities and planning decisions genuinely reflect measures of performance that are of interest to the system users" (*35*).

Criteria Challenges. The first step for Caltrans was to assess its multimodal system and develop a coordinated, cooperative process that would measure transportation system performance throughout California and support informed decisions by public officials, operators, service providers and system users.

The initial work plan included a review of existing performance measure efforts, identifying system outcomes, developing indicators (measures) that correlate to outcomes, and formulating an implementation scheme. Turning the work plan into a reality revealed a number of hurdles.

Caltrans worked through many challenges. The first was identifying the outcomes that reflected Caltrans' vision. Nine outcomes were identified: mobility/accessibility, reliability, cost effectiveness, sustainability, environmental quality, safety and security, equity, customer satisfaction, and economic well-being. They are described in more detail as follows (*35*):

- Mobility/accessibility—reaching desired destinations with relative ease within a reasonable time, at a reasonable cost with reasonable choices
- Reliability—providing reasonable and dependable levels of service by mode
- Cost effectiveness—maximizing the current and future benefits from public and private transportation investments
- Sustainability—preserving the transportation system while meeting the needs of the present without compromising the ability of future generations to meet their own needs
- Environmental quality—helping to maintain and enhance the quality of the natural and human environment
- Safety and Security—minimizing the risk of death, injury, or property loss
- Equity—Fair distribution of benefits and burdens
- Customer satisfaction—providing transportation choices that are convenient, affordable, and comfortable
- Economic well-being—Contributing to economic growth

Once the outcomes were identified, the indicators had to be determined. But these indicators had to be "mode neutral," with each indicator considering all transportation modes equally. Intermodal issues were prevalent to ensure that the measures developed were appropriate across all modes and excluded mode-specific indicators. For an overarching transportation network, this would be difficult to accomplish. Among other issues was the fact that, while most trips were found to occur intermodally, the transportation system is not managed intermodally (*35*).

Building on Successes. Caltrans had already been using basic forms of performance measures in its Maintenance and Operations division and for congestion management. These served as a basis for developing the other areas of performance measures. Building on the successes of the established measures allowed Caltrans to use the information and data already available. Caltrans made a concerted effort to strike a balance between simplicity and comprehensiveness in devising its performance measures.

In the year 2000, Caltrans released the first prototype model for performance measures. This framework was not intended for the entire state; it dealt predominantly with urban areas because they experience the most congestion and challenges with mobility, delay times, and infrastructure deterioration. Later on in the process, Caltrans developed performance measures for rural areas as well. Using the framework and data available for the urban measures, and modifying them to suit the unique scenarios encountered in rural counties, Caltrans continues to build upon its successes.

Currently, Caltrans' performance measures represent a keystone in the California Transportation Plan (CTP). The relationship between the CTP goals, performance measures/outcomes, and indicators are shown in Table 2 (*26*).

For most of the indicators, baselines already exist and annual targets are set. At the end of the fiscal year, performance is examined against the targets. If the targets are not met, the strategies are refined, interim benchmarks are reviewed and

Table 2. Relationship between CTP goals and transportation system performance measures/outcomes and key indicators.

CTP Goals	System Performance Measure/Outcomes	Key Indicators (Data to Collect and Report on)
Improve Mobility and Accessibility	▪ Mobility/Reliability/ Accessibility	*Travel Time (Mobility)* • Travel time within key regional travel corridors *Travel Delay (Mobility)* • Total person (passenger) hours of delay. Percentage on-time performance travel (Reliability) • Percentage on-time performance in key corridors
	▪ Coordinated Transportation and Land Use (Key indicators are included under the Accessibility outcome.) *Other additional measures under development.*	*Available Travel Choices (Accessibility)* • List modes available in key corridors and at key transportation centers • Percentage of workers within *x* (15, 30, 45, 60) minutes of their jobs • Modal Split (including choice ridership) • Percentage of jobs within a quarter/half mile of a transit station or corridor • Percentage of population within one-quarter/half mile of transit station/stop or bus corridor
	▪ Productivity	*Throughput—persons and vehicles (Productivity)* • Percentage utilization during peak period (highway) • Passengers per vehicle revenue mile (transit) • Passengers per vehicle revenue hour (transit) • Passengers miles per train mile • Percentage trucks by axle
Preserve the Transportation System	▪ System Preservation	*Highways, Streets, and Roads* • Pavement—smoothness and distressed miles • Bridges—structurally deficient or functionally obsolete • Roadside *Transit and Passenger Rail* • Vehicle fleet age • Miles between service calls *Aviation* • General aviation runway pavement condition
Support the Economy	▪ Ecoromic Development ▪ Return on Investment	*Measures Under Development*
Enhance Public Safety and Security	▪ Safety	*Traveler Safety* • Fatal/injury collisions and fatalities/injuries—rates and totals
Reflect Community Values	▪ Equity	*Measures Under Development*
Enhance the Environment	▪ Environmental Quality	*Air Quality* • Days exceeding national/state standards by region/air basin and statewide *Noise* • Number of residential units exposed to transportation-generated noise exceeding standards *Energy Consumption* • Fossil fuel use ratio to passenger miles traveled *Others Under Development*

Source: California Department of Transportation, California Transportation Plan 2025

resources are adjusted so that Caltrans continues to head in the right direction. For the "soft" indicators that are difficult to measure, data is being collected over several cycles so that a baseline can be established.

Reporting Results. Once the wheels were in motion for Caltrans, it and its partners realized the benefits of developing and implementing performance measures. Performance measures led to better decision making, candid communication with the public and other stakeholders, easier prioritization of projects and improving accountability. These positive results led to integrating the performance measures into the long-range plan.

Once Caltrans obtained results and gauged the relevance of the information, the decision to share the results with the Business, Transportation and Housing Agency (BTH) on a quarterly basis showed its confidence and its desire and ability to strive for excellence. More recently, in December 2007, Caltrans made its quarterly performance measure report available to the public for the first time. The online report included some vital measures, shown in the form of a "dashboard," i.e., a series of easy-to-read gauges (see Figure 4) that provide the viewer with a sense of the overall condition and status of Caltrans at a glance. The baseline, target, and current data, including comments, are included for each performance measure.

Caltrans had fully embraced a culture of performance-based management.

Contract for Delivery—Accountable Links in Performance Measures. Linking all facets of the Caltrans' project delivery process may not have been an initial goal when performance measures were first implemented. This by-product, however, has certainly become the final end product against which the system itself and Caltrans are measured. Perhaps one of the most difficult steps that Caltrans took was to link individual employee performance evaluations to the overall performance measures. In other words, the director of Caltrans and all district directors discuss the planned project deliveries for the following year. District directors sign a "Contract for Delivery" for the fiscal year that indicates a specific number of projects they will deliver. This agreement mandates great responsibility and accountability on the part of district directors, and their respective staff, to deliver the contracted number of projects on a quarterly basis. District directors meet on a regular basis with the director and review a STAR report which helps them track key milestones such as approval of the environmental document, ROW certification, plans, specifications & estimates, Ready to Let dates, and award dates for all the projects in the district. A "star" on this report indicates that the goal was met ahead of schedule.

Figure 4. Example of a dashboard gauge.

Conclusions

Caltrans continuously strives for a 100 percent delivery goal. With one decade of performance measure experience, Caltrans has combined system outcome with organizational goals and kept the local regional organization involved. Performance measures have allowed Caltrans to become more transparent to the public and other stakeholders through quarterly reporting of performance data against the baselines and targets. Above all, Caltrans had refined its ability to deliver programs and projects in record time, from the moment they are conceived to the time they are open for public use. For Caltrans, performance management is an all encompassing approach that has effected greater efficiency for California's transportation system and streamlined the processes through which ideas become realistic critical transportation networks.

Maine

A Bridge Program with Accountable Teamwork and Leadership

Maine is a small, rural state with an active and innovative state department of transportation. Maine ranks 39th in the United States in terms of area, 40th in terms of population, and 38th in terms of population density. (*37, 38*) In 2005, less than 30 percent of the state's VMT occurred in urban areas (the lowest among all eight case study states). (*39*) However, per capita VMT in Maine is about 11,300—about 13 percent higher than the national average. (*39*)

Maine has 22,236 miles of public roads. (*40*) Of these, 367 miles are interstate highways, 2,295 miles are arterials, and 5,595 miles are collectors. (*40*) The state owns and manages a network of 2,722 bridges. (*41*) Eighty-five percent of the state's lane miles are located in rural settings. (*39*)

Maine has 3,857 bridges, 70 percent of which are under the jurisdiction of the Maine Department of Transportation (MaineDOT). (*41*) Of the state-owned bridges, 14.4 percent are considered structurally deficient. That places Maine at 13th highest in the nation with regard to percentage of structurally deficient bridges. In 2007, MaineDOT estimated that without proper investment, the number of state-owned bridges considered in poor condition would double in 10 years, going from 9 to 18 percent. (*41*) MaineDOT's latest Long-Range Transportation Plan indicates that, in 10 years, the state runs the

risk of having nearly 10 percent of its bridges closed or posted at lower weight limits. (*42*)

The Long-Range Transportation Plan goes even further, clearly stating MaineDOT's view about its roadway system: "The State of Maine is losing ground in the struggle to maintain and improve the transportation system that is vital to its economic well-being." (*42*) It recognizes that the state has had to depend on a funding stream whose federal share has shrunk nearly 10 percent over the past 10 years. (A state motor fuel tax is the key non-federal source for highway/bridge projects.) It foresees a gap of between $2.5 and $3.3 billion to provide basic improvements to Maine's bridges, arterials, collectors, and other parts of the transportation system by 2030. Such improvements include replacing 30 to 40 bridges each year, modernizing almost 200 miles of inadequate arterials, and modernizing 1,850 miles of collectors. (*42*)

One critical note in the Long-Range Transportation Plan points to the relationship between long-term needs and the need for more effective and efficient delivery of services: "*before we receive new resources, we must demonstrate to [the governor] and the legislature that we are maximizing the benefits from every taxpayer dollar we already receive.*" (*42*)

Organizational Structure—The Team Approach

At the beginning of the 21st century, MaineDOT formalized a change in organizational structure, such that the highway and bridge programs function in a team approach. Prior to this change, the organization has been described as an "assembly line," with handoffs from one group to the next, each operating as a "silo" or "stovepipe," both organizational metaphors that essentially depict a vertical structure designed to keep what is inside from interacting with the surrounding environment. In sharp contrast, the team approach brings representatives of various key divisions together, typically led by a project manager who guides the team—and the project—from planning through construction. Multimodal projects typically include outside consultant representatives on the team.

The team approach has been described as having "significantly helped in the acceleration of programs." (*43*) It also has been cited as helping in employee retention and growth. Some of the following positive opinions of the team approach that were indicated are noted:

- Teams have significantly improved communications. There are frequent team meetings and self-directed teams.
- Teams have played a significant role in helping to retain trained employees. It broadens their work experience while challenging them with a variety of responsibilities.
- Teams are more efficient. Almost everyone is a part of the project team and provides input into a project budget and schedule.
- Teams produce urgency. There are real deadlines and lines of responsibility. "We can't hide things anymore."
- The chain of command is simpler, with more accountability. Team leaders can make decisions.

There are, however, issues with the team approach that everyone must address for them to be successful. The team approach requires significant buy-in and effort in order to be effective. It takes added effort to set up team meetings to ensure that all parties are represented. Managing a team is an important skill that needs to be learned. The team leader needs to address these ongoing issues (*43*):

- Input from team members is important, but ultimately the project manager needs to be able to make decisions.
- One has to watch out for the "squeaky wheel," the team member who by dint of personality or seniority can tend to overpower the team, and seemingly force the rest of them to follow.
- The team leader needs to know how to aim for and recognize consensus. It is not always easy to establish.
- Teams are encouraged to take risks, e.g., employ context-sensitive solutions, but this is not always easy to do, since adherence to AASHTO standards has long been institutionalized as a major part of the training and experience for many MaineDOT employees. Team leaders need to encourage risk taking, while still recognizing the need for adequate backup for important design choices.

In addition, at MaineDOT, the environmental unit is not formally a team member. Some believe that the environmental department very much needs to be part of the team. Right-of-way personnel are part of the teams, but a dedicated staff member at the central Bureau executes the final property condemnation for all projects. Some project managers see this as a potential bottleneck that prolongs the project schedule regardless of their efforts to expedite other tasks. Thus, there are important issues that project managers at MaineDOT face and try to deal with constructively when institutional trade-offs require a mix of team and non-team approaches.

An important part of the team approach is that it encourages—and nearly requires—cross training of MaineDOT personnel. Engineers will need to serve as project managers from scoping through design and into construction. The goal, or effect, is for the individual engineer to learn many aspects of many different jobs. This cross-training not only produces effective project managers, but further adds to employee morale and employee retention.

One final point should be made about organizational structure: MaineDOT has five regional offices, but the highway program is very centralized. "Regions are not fiefdoms," said one official. "Key support staff is in Augusta; uniform

policies are established and are maintained statewide. It is a struggle to maintain regional consistency, but we do a good job . . . via monthly meetings with the regions." Another aspect of centralized activities occurs in the Property Office. Capabilities now exist to obtain statewide multiple-listing services online. Information about sold properties can easily be extracted and helps the state make reasonable offers for needed property. Appraisers are able to obtain information in 15 minutes, as opposed to a week of work in the field. As one official noted, "Maine . . . is small enough so that everyone can work closely. The organizational matrix works well. Regional and central responsibilities go across lines." (*43*)

Accelerating Design and Construction on Critical Projects

MaineDOT describes itself as reacting especially well to crises—quite simply, it heightens the sense of urgency. The two projects discussed in the following paragraphs were noted by MaineDOT as examples of successful fast-tracked projects.

Verona-Bucksport Bridge Replacement Project

The Verona-Bucksport Bridge Replacement Project was completed in 30 months. The original bridge was identified as a failing structure. Project acceleration was achieved through a multipronged approach. For instance, MaineDOT insisted on what was almost literally a shotgun-enforced teaming of design and build functions. There were between 30 and 40 day-long meetings among the designer and contractor. All efforts were made to expedite environmental review. There was extensive, early, and continuous community involvement. However, MaineDOT points out that, largely because of the historical nature of the existing bridge, it was not possible to gain a consensus of public support for the project. On the other hand, MaineDOT considered early disclosure of the estimated project cost to be important in winning support among some stakeholders.

There was a strong effort to utilize CSS in the design process. It was acknowledged that the existing bridge was historical, but the failing structure could not be preserved. Its historical nature led MaineDOT to incorporate new historical and appealing aspects to the new bridge: incorporating an observatory into the design of a support pillar and using elements and materials from other well-known historical structures. To accomplish this, MaineDOT maintained a strong relationship with the Maine Historic Preservation Commission, the state historic preservation office.

Interstate 295 Resurfacing Project

Several miles of I-295 were scheduled to be resurfaced over three construction seasons. However, when an inspection found the pavement to be in worse shape than anticipated, the resurfacing work urgently needed to be done sooner than planned. The idea was put forth to fast track the resurfacing to three months, which would require the closing of all lanes along the southbound side of I-295 during that period. MaineDOT officials cite several reasons as to why this project acceleration was so successful. (a) Early and continuous public outreach was conducted. This consisted both of meetings with local officials about detour routes and other meetings with the public about the need for the project. Slabs of the deteriorating concrete were exhibited at public meetings to clearly show the severe problems of the pavement. It was felt that if the public understood the need and the problems generated by the pavement condition, there would be a better likelihood of buy-in despite the inconveniences imposed by such a major detour. (b) Also, significant media attention was generated by the outreach effort. (c) Internally, staff-related efforts were undertaken, including cross-training of staff, shifting of supervisory personnel, and the establishment of managerial champions for the project.

One of the challenges associated with accelerating a critical project is the effect it may have on other, non-crisis programs. Among mid-level managers, the perception exists that concentrating all efforts on accelerating a large project (as was the case with the I-295 resurfacing) can actually delay the delivery of the remainder of the program. It is important to give vent to these perceptions and formulate a plan, when focusing on a super-critical project, to move ahead on schedule with the rest of the program.

Bridge Legislation and Project Prioritization

As stated earlier, MaineDOT oversees nearly 2,800 bridges. Nearly 16 percent are considered structurally deficient, and many more are likely to deteriorate over the next 10 years. (*41*) To address this problem, the Maine state legislature passed two significant pieces of legislation that helped to expedite bridge projects. In 2001, the Local Bridge Program (LBP) divided responsibilities for various types of spans between MaineDOT and towns. It made MaineDOT responsible for all larger bridges and the towns responsible for smaller spans on town ways. It allowed MaineDOT to focus its capital and maintenance efforts on larger bridges that need it. State Highway Fund dollars are conserved by better leveraging federal funds, because only bridges with a span of more than 20 feet are eligible for federal funding. MaineDOT could fulfill its responsibility for bridge safety by continuing to inspect all smaller spans and larger bridges every two years. Most important, the larger bridge projects could be delivered quickly, without the cumbersome process of calculating cost-shares, letters offering projects, town funding authorization, preparing town billing, processing town payments, and resulting delays.

Table 3. Breakdown of capital bridge improvements funded by Maine's bridge investment plan.

Types of Improvements	Quantity
Bridge Replacements	80
Bridge Improvements Not Yet Scoped	59
Bridge Rehabilitations	10
Bridge Removals	6
Minor Spans	27
Bridge Preservation	64
Total	**246**

Source: Maine Department of Transportation (*44*)

In 2008, the state legislature created a funding source for MaineDOT to provide $160 million ($40 million per year) to supplement the currently anticipated bridge funding of approximately $280 million ($70 million per year), to create a $440 million, four-year bridge investment plan. (*44*) This plan represents a bold step toward addressing the bridge funding recommendations contained in the November 2007 report to Governor Baldacci entitled "Keeping Our Bridges Safe" (the Bridge Report), as well as the goals in 2007 P.L. Chapter 470 "An Act to Secure Maine's Transportation Future," both of which have been incorporated into "Connecting Maine," MaineDOT's Long-Range Transportation Plan.

Among all the case study states analyzed in this report, Maine is the only state that has created this special bridge funding source. This legislation identifies and funds 246 badly needed capital bridge improvements in every corner of Maine. Table 3 presents highlights of this bridge investment plan.

MaineDOT officials played a strong role in creating the list of 246 bridges. The four-year funding has created a strong urgency within MaineDOT to undertake these additional bridge projects expeditiously—in some ways similar to the urgency created by the Verona-Bucksport bridge replacement project and the I-295 resurfacing project.

The Evolution of Performance Review—The Bridge Program

In 2004, MaineDOT's bridge program instituted the first form of project performance review in the DOT. Known as "Quality Assessment of Completed Bridge Projects," it measured the quality of the work performed on various bridge projects. Scoring was based on a 1 to 4 scale with 1 being unsatisfactory and 4 being exceptional.

Scores were assigned to five criteria:

- **Safety Quality:** Effective maintenance of traffic during construction; improved safety to traveling public, pedestrians, and bicyclists; use of safety features on structure or approaches.
- **Environmental Compatibility Quality:** Aesthetically pleasing; fits into surroundings; minimal or no environmental impacts; improved environmental conditions; historical or archeological integrity maintained; minimal or no ROW impacts; good erosion control during construction; satisfied public.
- **Functionality Quality:** Meets purpose and need; appropriate structure type; appropriate structure size; effective use of right-of-way; effective accommodation of pedestrians and bicyclists; effective accommodation of boats and trains.
- **Cost-Effectiveness Quality:** Appropriate scope of work; good workmanship ensured; low-maintenance structure type; durable materials used; reasonable life cycle costs; effective use of extra work or change orders; reasonable project costs; effective design, plans, and specifications.
- **Overall Quality**

Baseline target quality scores were assigned by a quality assessment team (QAT) to projects and then compared to the overall quality score assigned by that QAT at the project's completion. The overall quality score measures a great deal about the construction process (including costs), as well as an overall assessment of how well the project performs from safety, environmental, functional, and public reaction perspectives. What it doesn't do is measure aspects of a project as it progresses through the pipeline.

To begin tracking projects as they move through the pipeline, MaineDOT has begun to implement a new dashboard tracking system for all projects. The dashboard tracks projects that are identified in MaineDOT's Biennial Transportation Improvement Program (BTIP) and its Biennial Maintenance Activity Plan (BMAP). It classifies projects into three categories:

- **Green:** Two types of projects are in the green category:
  - Projects that have just been kicked off
  - Projects that remain in the following parameters:
    - Scope stays consistent with the Scoping Report.
    - Estimated expenditures stay within seven percent of programmed amount.
    - Four or fewer change orders.
    - Project schedule stays within 25 days.
- **Yellow:** Projects move to yellow parameters when:
  - Project experiences a minor scope change from the Scoping Report.
  - Project falls 25 to 40 days behind schedule.
  - Project experiences five to nine change orders.
  - There is municipal unrest concerning the project.
  - Project cost estimate exceeds programmed amount by eight to twelve percent.

- **Red:** Projects move to red parameters when:
  - Project experiences a significant scope change from the Scoping Report.
  - Project falls 40+ days behind schedule.
  - Project experiences 10+ change orders.
  - There is municipal/civil unrest concerning the project.
  - Project cost estimate exceeds programmed amount by more than 12 percent.

Figure 5 shows additional information on the criteria, decision making, and issues associated with each category.

The purpose of this dashboard is to uphold accountability, keep projects in the green, move projects from yellow to green, and learn from projects in the red.

The extent of oversight that projects receive has to do with which category a particular project is in. Project managers are responsible for providing regular status updates to MaineDOT management. The project managers and their teams make all decisions about projects categorized as green. The overall BTIP and BMAP are managed by a Workplan Management Team (WMT), made up of MaineDOT management officials. When projects move into the yellow category, the project manager and other key team members must meet with the WMT. The meeting determines why this shift occurred, and whether the project can move back into the green category. If it moves back into green, basic scoping assumptions are likely to change. If a project moves into the red category, the project manager and key team members will meet with senior management at a monthly meeting and discuss how it happened. Senior management will decide if the project is to be shelved or moved back into the green (along with revised scoping assumptions).

Environmental "Streamlining"

Changes in the Environmental Office at MaineDOT have had the net effect of informally "streamlining" the environmental review process that often slows down projects in the pipeline. The Environmental Office maintains strong relationships with state and federal environmental agencies. These relationships help expedite the review process by building understanding and credibility between these agencies and MaineDOT. Key permitting questions are resolved early on. For instance, does a project need a permit, or can a permit be avoided early on by changing the design? As Bridge Program officials stated: "Rule No. 1 is to stay out of the water." (*43*) Finally, a MaineDOT waterway and wildlife crossing policy is being developed to help project developers better understand these environmental issues.

Lessons Learned and Conclusions

There are two overall lessons learned from the MaineDOT case study that are useful to other states. One is the team approach and the second is a comprehensive performance tracking program.

The team approach is motivating and engaging and provides more accountability. By eliminating handoffs, it saves time. Through active engagement and cross-training, it builds a strong and experienced workforce—one capable of accelerating both programs and individual projects. It fosters cooperative planning, design, and decision making, which further strengthens MaineDOT's ability to team and work with the public, elected officials, other stakeholders, and other state and local agencies, as well as important federal agencies.

Comprehensive performance tracking is critical. In developing the dashboard system, MaineDOT has the ability to improve its project delivery process by having a standard method by which projects are continually monitored and reviewed. This standard helps ensure that projects do not fall behind schedule, become neglected, or become mismanaged.

In summary, accountable teams and performance tracking of its efficient bridge program are MaineDOT's path towards an expedited project delivery system.

Maryland

Performance Measures for Program Delivery

Maryland is a small state, ranked 42nd in the nation in area. (*37*) However, with an estimated 2008 population of over 5.6 million, it is the fifth densest state in the United States. (*38*) Maryland is geographically quite complex and is roughly divided into three areas. The western part, bordered by West Virginia and Pennsylvania, is mostly rural. Central Maryland, including Baltimore and the Washington, D.C. suburbs, is quite urbanized and dense. Eastern Maryland, defined by the Chesapeake Bay, is primarily agricultural and enjoys a large amount of tourist traffic primarily destined to the Eastern Shore.

Maryland's per capita VMT is nearly the same as the U.S. average, with nearly 75 percent of it occurring in urbanized areas. (*45*) But surprisingly, Maryland's annual VMT has remained nearly constant since 2005 at approximately 56.5 billion. (*45*)

There are 29,265 centerline miles of roadway in the State of Maryland. Of this total, SHA maintains 5,243 centerline miles. (*46*) Although this represents less than 20 percent of the total roadway miles in the state, these highways account for approximately 70 percent of the total VMT in the state. (*46*) The 5,243 miles of highways maintained by SHA are categorized for funding purposes as primary and secondary highways. The state primary systems consist of approximately 1,288 miles of state-maintained routes, or 25 percent of the total state-maintained road mileage. (*46*) The secondary system is a network of state routes that serve interregional and localized traffic. This network consists of 3,955 miles (75.45 percent)

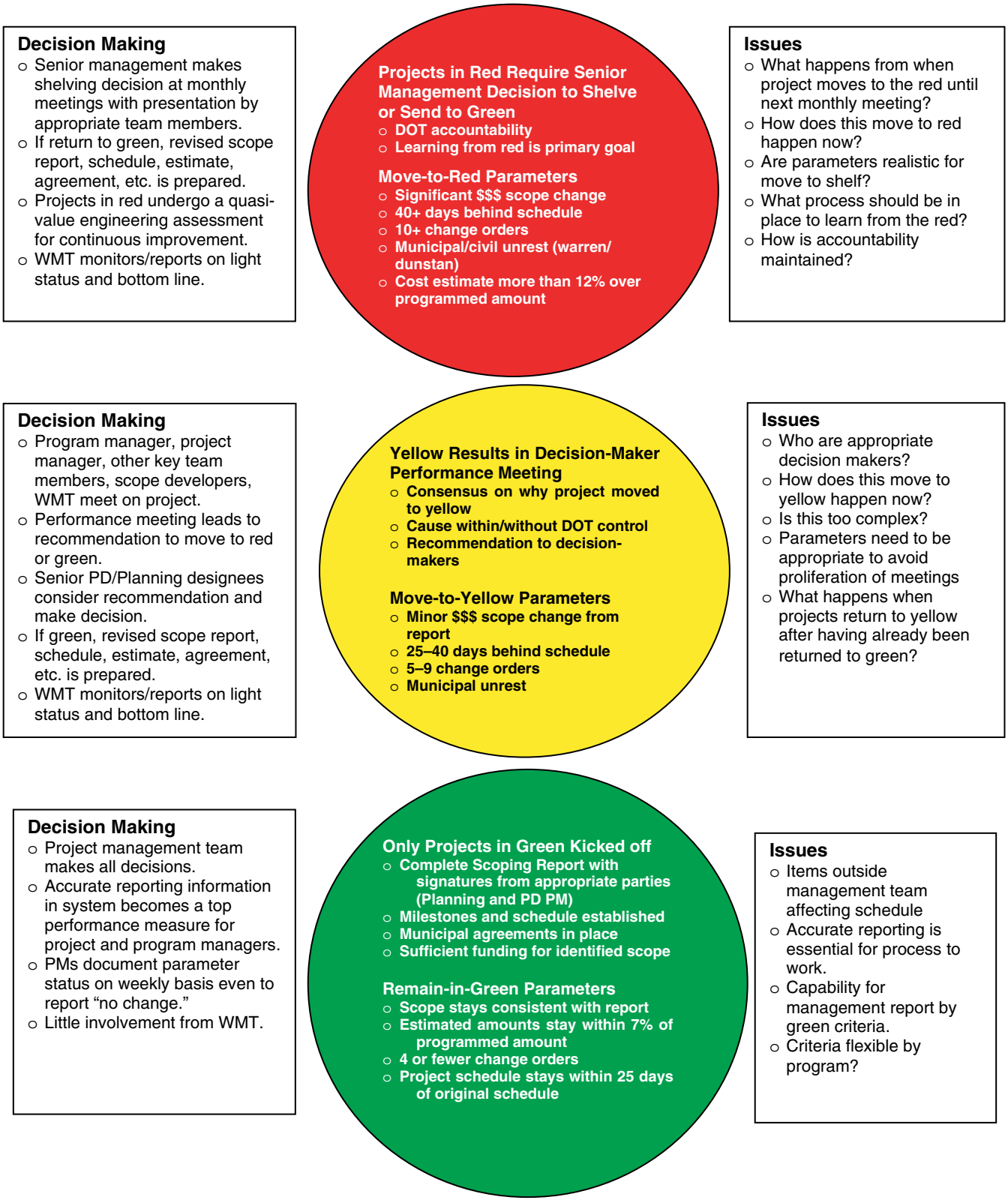


Figure 5. BTIP/BMAP process: Managing the work plan.

of the total state-maintained roadways and provides feeder and support functions to the primary system. (*46*)

Transit in urban areas includes subway, light rail, and bus. Commuter rail connects Washington, D.C. to Baltimore. The Washington Metro subway and bus system serves Montgomery and Prince George's counties. Long-haul passenger rail service is provided by Amtrak.

Maryland's geography is strategically located along the eastern seaboard and is poised to grow its economy which is based in traditional manufacturing, wholesale and retail trade, transportation, financial services, agriculture, and government contracting. Growth in these areas in the last decade has increased Maryland's gross state product from $162 billion to $273 billion in 2008. (*47*) This translates to a robust economy in which the median household income is ranked the third highest at $66,500, well above the national average. (*48*)

This growth has been supported by a multimodal transportation network that the Maryland Department of Transportation (MDOT) is committed to enhancing and maintaining. Maryland's projections that freight movement will increase dramatically in the next decade will impact the roads and highways as well. It is expected that Maryland's freight industry will grow by 120 percent statewide between the years 2000 and 2030. (*49*) Currently, approximately 82 percent of freight tonnage moves on the highways. Maryland is also a "through" state for freight movement, with half of the tonnage simply passing through. As a result, the state experiences more wear and tear on its aging infrastructure.

Organizational Structure

The organization of the MDOT is unique among the eight states studied, in that the transportation secretary oversees six separate modal administrations as shown in Figure 6.

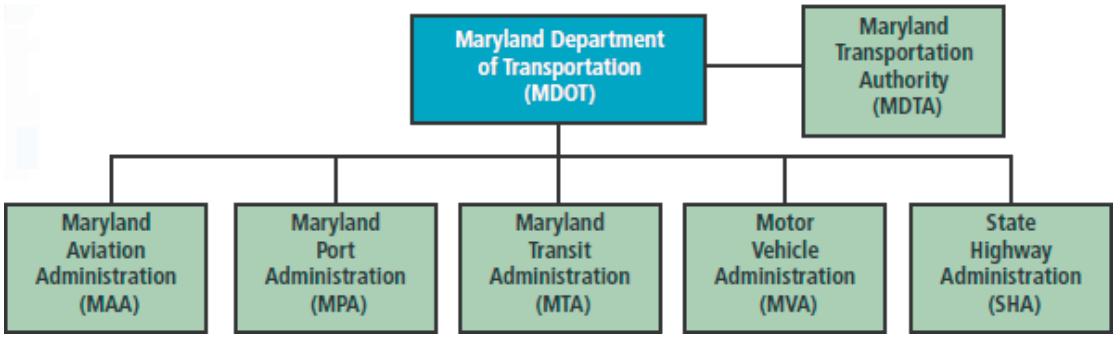
The last of these modal agencies, SHA, received the most attention in this study, as it has jurisdiction over the state's highway network, similar to the role played by the department of transportation in other states. Not surprisingly, over half of MDOT's capital program is allocated to SHA. (*50*)

While MDOT as a whole reduced its total number of positions by 7.6 percent since 1992 (*50*), SHA in particular has become more streamlined, reducing staff by about 25 percent. SHA is overseen by an administrator with three deputies: operations, administration, and planning/engineering. SHA's capital investment, bridge, geometric, and ROW divisions are centralized, reducing redundancy and improving streamlining between the agencies.

Interviewed SHA officials noted that they were organized in a manner that values the role of individuals in the organization. Unlike some of the other case study DOTs, SHA has moved toward specialization of individuals. In the view of those interviewed, this has allowed staff in various areas to develop a level of competency in their subject area that shortens the length of time they are involved with a given project, leading directly to that project's acceleration. Other perceived benefits of specialization include the following:

- Provides one point of contact for key subject areas
- Creates a stable, streamlined process
- Ensures that tasks are executed correctly the first time, thereby reducing backtracking
- Provides each technical specialty with the ability to track the project's schedule
- Builds trust among review agencies by allowing them to work with the same SHA personnel all the time. They feel a sense of consistency and confidence when they don't have to walk a new SHA project manager from square one through the entire process for every project.

SHA had at one point experimented with the concept of keeping one project manager on a project from scoping through construction. However, a key problem kept recurring: Project managers would be promoted to a different position or leave the agency, resulting in the need for project handoffs to a new project manager. As a result, SHA began to move toward project specialization.



Source: Maryland Transportation Plan, 2009

Figure 6. Organizational chart for the Maryland Department of Transportation.

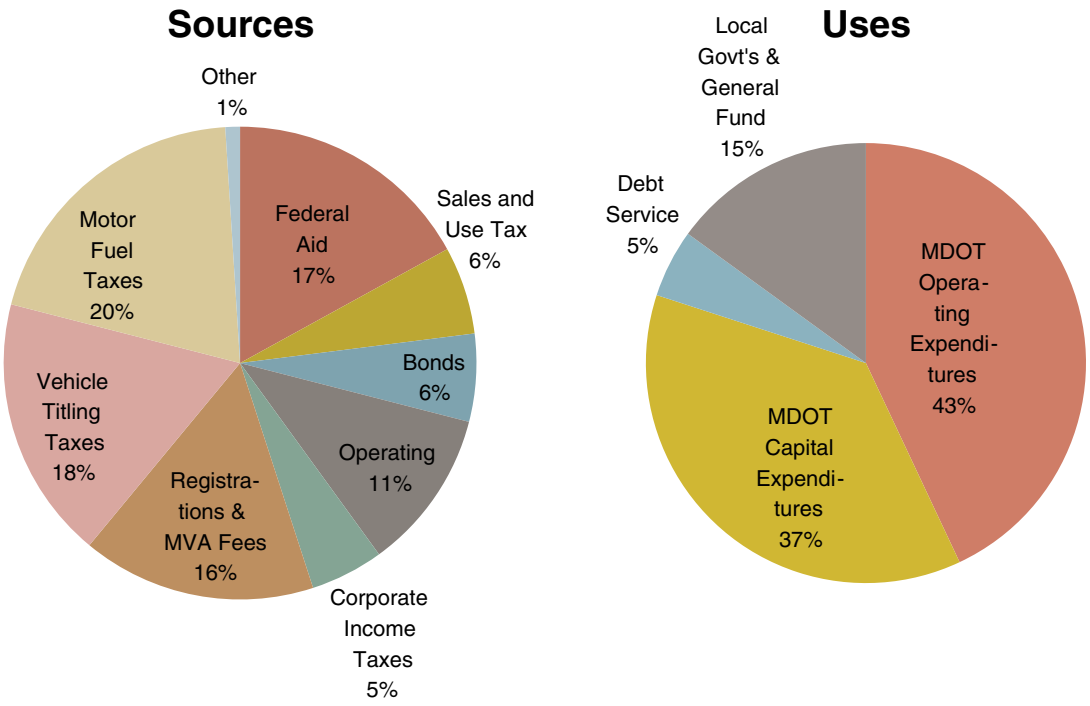


Figure 7. Sources and uses of the Transportation Trust Fund.

Transportation Trust Fund

Securing funding is obviously a critical component for timely project completion. Maryland's method of funding projects is notable and has been adopted by other states. A centralized, dedicated fund is set up for all of the state's transportation needs. This fund is separate from the state's General Fund, which supplies funding for other government programs. Revenues are not earmarked; fund allocations are made with input from local elected officials. Sources of funds include taxes, fees, and federal aid, as shown in Figure 7. Bonds are issued to support the cash flow requirements of a given capital program in a manner mindful of debt coverage requirements.

The Trust Fund gives the state a great amount of the flexibility required to meet the needs of a diverse transportation infrastructure through a stable source of revenue. By having such secure funding, MDOT is able to ensure projects travel from design through completion.

Maryland Transportation Plan

MDOT recognizes that long-term planning is essential for the population growth, diversifying economy, and changing environment that are imminent. The vision for a sustainable preserved environment and a safe and reliable highway system is outlined in a 20-year plan. The Maryland Transportation Plan (MTP) is only one of three documents that define a framework of policies and priorities that help guide transportation investments across all modes. (*51*) Figure 8 illustrates that the State Report on Transportation also comprises

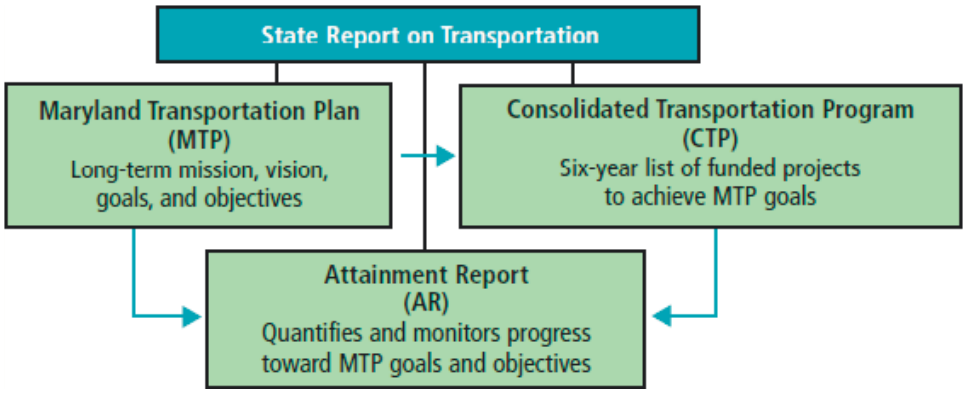


Figure 8. Relationships of the State Report on Transportation documents.

the Consolidated Transportation Program, a short-term, six-year plan that defines a list of funded projects, and the Attainment Report, a product of MDOT's performance measure program.

In developing the MTP, the MDOT used an intense public outreach effort to gather information. It involved state, regional, and local agencies to ensure that its strategic planning efforts could correlate with the state efforts. Citizens and stakeholder groups were contacted through interviews, facilitated meetings, interactive websites, newsletters, and online surveys allowing countless citizens, many of whom would not have been included in traditional settings, to participate in the statewide issues. (*51*) Their contributions and a broad-based approach identified six critical challenges: (a) transportation and the economy, (b) freight demand and infrastructure capacity, (c) planning for development, (d) transportation and the environment, (e) transportation needs outpacing funding resources, and (f) transportation-related fatalities and injuries. The MTP addresses these challenges in detail but also outlines a strategic direction to deliver the MDOT's mission.

Five goals identify and support the vision (*51*):

- Quality of service
- Safety and security
- System preservation and performance
- Environmental stewardship
- Connectivity for daily life

The goals, in turn, are addressed through a series of performance measures that are reported in the Attainment Report. Maryland's approach to transportation is comprehensive in that the MTP long-range vision is broken down into the Consolidated Transportation Program's short-range plans, which then are implemented through the mission and goals of the MDOT by application of performance measures.

System Preservation and Performance

Maryland is predominantly in the mode of preserving its infrastructure in this difficult climate of limited funding, as evidenced in the third goal. "Fix it First" is the motto before additional funds are expended in expansion-type projects. Almost 43 percent of the MDOT's capital expenditures go into system maintenance and preservation. (*52*) With an emphasis in preserving the infrastructure so that it operates efficiently, the MDOT can extend the useful life of its assets and invest remaining funds for expansion of the network.

Environmental Stewardship

Environmental stewardship is also a prime goal for SHA. MDOT takes a lead role in protecting the air, water, soil, and ecosystems of the state. Their priority under the governor's Smart, Green and Growing initiative is to promote smart growth so that developments occur in areas where infrastructure already exists. It is a balanced approach to preserving natural resources, optimizing the use of existing facilities, reducing the cost to taxpayers, and increasing quality of life. Context-sensitive solutions play a large role in project development and, like many other states, Maryland struggles to balance the cost and time involved in incorporating CSS against accelerating project delivery.

A Standard Operating Procedure of Thinking Beyond the Pavement

SHA views context-sensitive design (CSD, also known as context-sensitive solutions or CSS) as satisfying the "need to invest in community opinion from the very beginning." It describes CSD as "a collaborative, interdisciplinary approach to developing and implementing transportation projects, involving all stakeholders to ensure that transportation projects are in harmony with communities and preserve and enhance environmental, scenic, aesthetic and historic resources while enhancing safety and mobility." (*53*)

For SHA, noise walls, especially, face a variety of community-to-community opinion, where CSD is especially helpful in building consensus. SHA's commitment to CSD is so fundamental that when asked about it, many members of the agency viewed it as simply a normal operating procedure.

The main goal of CSD is not to accelerate projects but rather to enhance their acceptance by the community by ensuring that they meet the communities' goals and objectives. However, better design leads to better community acceptance, which may ultimately speed some projects by ensuring they avoid massive resistance.

Additionally, when viewed as a long-term investment, integrating CSD into transportation project design may help project timeliness by building a foundation of trust and consensus between agencies and communities. That is, once communities trust agencies to be sensitive to their needs and environment, resistance—which may ultimately lead to delays through lawsuits or political pressure—is less likely to be met throughout the project.

The strong community involvement that is part and parcel of CSD does raise the public expectation of a project reaching completion. When a project fails to move out of the planning stages, it may produce both disappointment and mistrust by community members. SHA has noted that the public needs to be made aware that not all project concepts progress to completion, while others may take longer than expected because of funding uncertainties. SHA also noted that not all local officials fully understand or have bought into CSD. These officials often chafe at the level of community involvement that

SHA engages in, preferring more of a one-on-one relationship between SHA and the municipal leaders.

In the end, Maryland's view is straightforward—it is "Thinking Beyond The Pavement" (TBTP). Four task teams (Organization and Policy Task Team, Project Development Process Team, Community Involvement Team, and Project Management and Leadership Development Training Team) and their subteams have tasks and action items well defined to fully incorporate CSD/TBTP principles into their projects. MDOT develops and builds its facilities so they fit within the physical environment. This requires an adherence to the implementation strategies and a DOT culture that supports TBTP initiatives.

Best Practices for Maryland

Performance Measures—The Annual Attainment Report

Rather than the dashboard approach used by other state DOTs, MDOT publishes the Annual Attainment Report on Transportation System Performance. This report is truly an integrated effort of tracking, monitoring, and attainment efforts of the six agencies that make up MDOT. Numerous adjustments have been made in what is measured and setting specific goals since MDOT began tracking its performance in this report in 2002. However, MDOT is now able to report on a multiyear trend for each performance category. The measures and trends are represented in the Attainment Report on graphs and charts, and a written explanation is also provided for each in the form of responses to questions such as "What is the reason for the change?" and "What is to be measured in the future?" Every question is answered by two or three bulleted items explaining the metrics.

What begins as five goals for MDOT are divided into performance measures that each of the agencies are accountable for. Currently, MDOT tracks a total of 58 measures that provide individual gauges of Maryland's entire multimodal transportation network. For instance, for the goal of system preservation and performance, 12 measures are tracked and monitored, but all six agencies are responsible for meeting this goal. Responsibility for another of the goals, environmental stewardship, is illustrated in Table 4. The eight measures that come under this goal are monitored either by MDOT or by one or more of its modal agencies.

Metrics tracked by SHA include the following (*45*):

- Maryland driver satisfaction rating (based on a weighted average score for 22 questions)
- Percentage of state highway network in overall preferred maintenance condition
- Bicycle and pedestrian fatalities and injuries on all Maryland SHA roads
- User cost savings for the traveling public due to incident management
- Acres of wetlands restored and miles of streams restored
- Total fuel usage (SHA-dispensed fuel contains ethanol) of the light fleet
- Number of SHA park-and-ride spaces and reduction in VMT through park-and-ride usage

Table 4. Performance measures and monitoring agencies for MDOT's environmental stewardship goal.

Performance Measure	Monitoring Agencies
Transportation-related emissions by region	MDOT
Transportation-related greenhouse gas emissions	MDOT
Transportation emission reduction measures	MDOT & MTA
Acres of wetlands or wildlife habitat created, restored, or improved since 2000	MPA
Compliance rate and number of vehicles tested for vehicle emissions inspection program versus customer wait time	MVA
Acres of wetland restored and miles of streams restored	SHA
Total fuel usage of the light fleet	SHA
Travel demand management	SHA & MTA

Source: Maryland Department of Transportation, 2009 Annual Attainment Report (*45*)

- Percentage of SHA centerline miles with a bicycle level-of-comfort grade "D" or better and mileage of highways with marked bike lanes
- Percentage of SHA centerline miles within urban areas with sidewalks and percentage of ADA-compliant sidewalks

The Maryland Transportation Authority (MdTA) is an independent agency responsible for managing the state's toll facilities. The Intercounty Connector and the John F. Kennedy Memorial Highway, a 50-mile tolled section of I-95 from Baltimore's northern city line to the Delaware border under MdTA's jurisdiction, are combined with the SHA's roads for the purpose of calculating and reporting on the following performance measures (*45*):

- Annual number of traffic fatalities and personal injuries on all Maryland roads
- Number of bridges and percentage that are structurally deficient
- Percentage of roadway miles with acceptable ride condition
- Percentage of freeway and arterial lane-miles with average annual volumes at or above congested levels

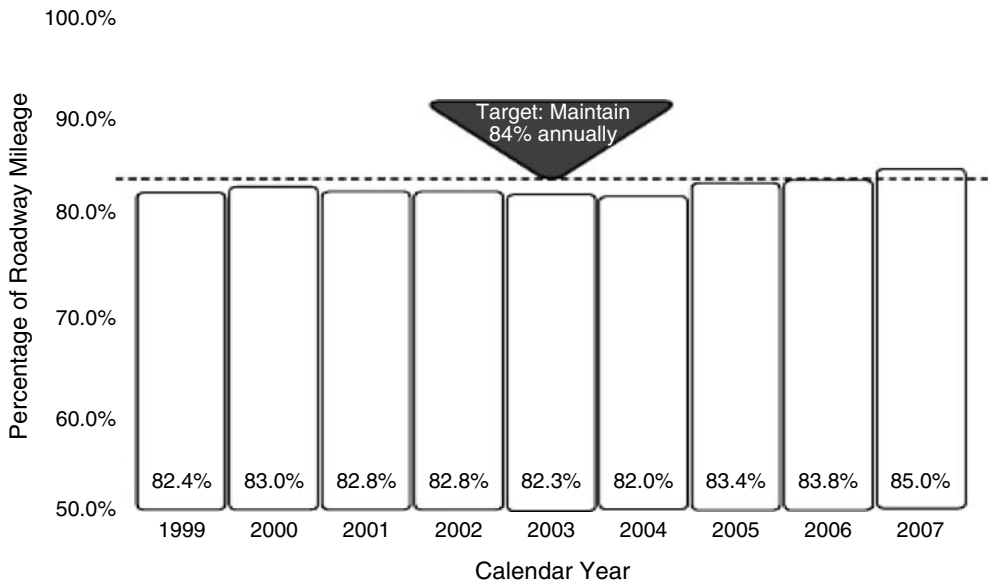
The graphs and charts that represent the performance of each of the metrics also set a target for the upcoming years. For example, the smoothness or roughness of the pavement ride quality, which facilitates mobility, efficiency, and safe movement of people, is shown in Figure 9 in the form of a bar chart. SHA and MdTA actually exceeded their target in 2007.

Figure 10 shows a target of reducing the number of fatalities to less than 550 by 2011. In 2007, Maryland reported 615 fatalities. The Attainment Report explains reasons for the performance change and strategies to continue a downward trend.

Similarly, each measure charts a trend that is benchmarked every year (or biennially for some measures). Targets are set and MDOT managers and leaders are tasked with meeting the goals of the department.

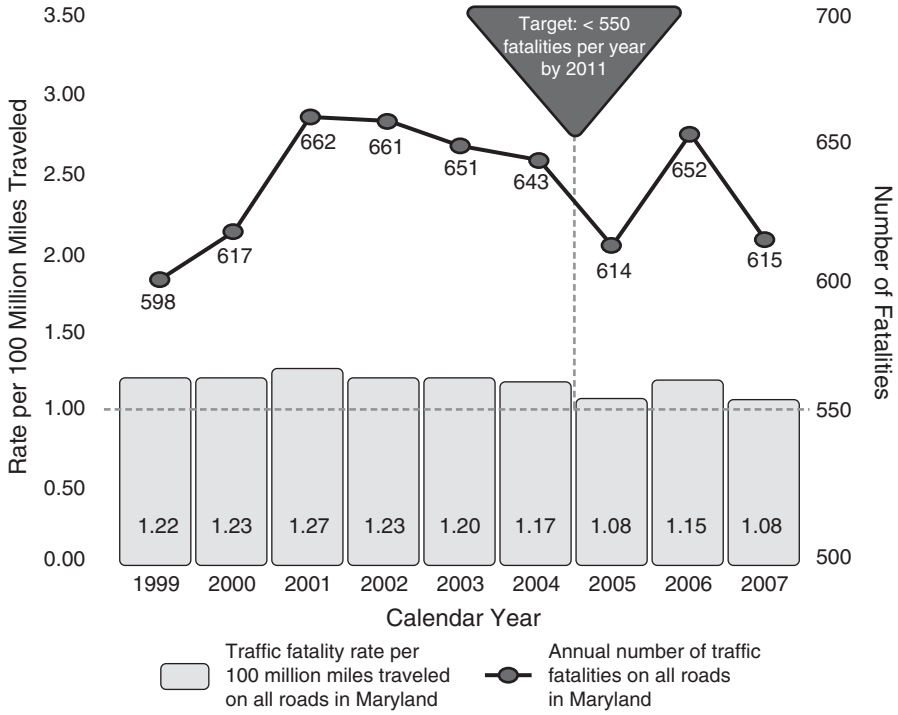
The 58 performance measures are reported "externally," i.e., to the public, via the Internet and through publication of MDOT's Annual Attainment Report. While many states are still attempting to embrace a performance measurement or management system, Maryland has managed to assess its infrastructure and benchmark its assets for the past seven years. The realistic targets help managers to reach for the annual goals through the strategic alliance of all agencies involved. It is a self-assessment of their services, their economy, environment, and quality of life. The Attainment Report holds MDOT to the highest level of accountability and transparency.

It was pointed out by the interviewed SHA personnel that measuring whether projects are being delivered faster is a difficult endeavor: Projects are not all alike, funding availability differs depending on when a project begins, satisfying the owner and customer(s) can be an elusive goal, and CSD sometimes extends the project's schedule. For these reasons, MDOT hasn't been able to measure changes in the speed of project delivery *per se;* however, it is measuring its ability to meet its commitments to deliver projects as well as its commitments to environmental stewardship. While it hasn't completely met its goals as yet, it is improving in its ability to meet them.



Source: Maryland Department of Transportation, 2009 Annual Attainment Report (*45*)

Figure 9. Percentage of roadway miles with acceptable ride conditions.



Source: Maryland Department of Transportation, 2009 Annual Attainment Report (*45*)

Figure 10. Annual number and rate of traffic fatalities on all roads in Maryland.

Accelerating the Intercounty Connector

The Intercounty Connector (ICC) was a large project designed to relieve congestion between the I-270/370 and I-95/US 1 corridors within central and eastern Montgomery County and northwestern Prince George's County with a new multimodal highway. Technically, the ICC project was first conceived on a high level in the 1950s, but a lack of funding and urgency delayed the project until the 21st century. Once the decision was made to prioritize the project, however, numerous methods were employed to successfully accelerate the design and construction phases.

Environmental Streamlining. The ICC's environmental process was completed extremely quickly, utilizing a number of techniques. Some of these methods had been successfully applied by SHA to the Woodrow Wilson Bridge replacement earlier in the decade. First was the formation of an Interagency Working Group (IWG) dedicated to this project alone. When the IWG could not resolve issues, a formal group consisting of agency principals plus one support person ("P+1") was convened. The IWG and P+1 meetings both employed a neutral facilitator to expedite an effective process.

In addition, the NEPA process was tracked with an eagle eye—high-level officials, including the governor, the secretary of transportation, and the SHA administrator, were closely involved in the environmental review process on a frequent basis. This involvement included a great deal of up-front and senior-level attention to creating the project purpose and need, as well as a significant amount of effort spent on developing alternatives.

SHA acknowledges that this streamlining process accelerated the design and construction of the ICC and that the manpower shifts undertaken to deliver this MdTA-owned facility adversely affected other projects in SHA's pipeline, causing some to fall to a lower priority. However, SHA also acknowledges that "staff came back from ICC working harder and with a greater sense of urgency, realizing that they can do more." This realization has led to a number of practices that have helped expedite projects, including weekly breakfast club meetings for team leaders to discuss specific projects. (*54*) In addition, a number of environmental streamlining practices have been adopted, including the following:

- **Working with agencies during the planning process to begin the permitting process.** This entails a number of things: Preparing a single document to satisfy both NEPA/Clean Water Act Section 404 and the Maryland Clean Water Action Plan, completing the mitigation package before (or at least during) and not after the design stage, and getting corridor permits early.
- **Making staffing agreements with other agencies.** SHA funds staff positions in regulatory agencies and retains

consultants for other agencies, for the purpose of expediting the review and approval process for its projects.
- **Banking stormwater.** Building surplus stormwater recharge into larger projects offsite to avoid the need for site-specific replacement or mitigation on small projects.
- **Gaining programmatic approvals.** Certain actions can be approved programmatically rather than on a case-by-case basis. Depending on their scope, some entire programs can be delivered faster through this means.

Design–Build Contractor Selection Based on Competitive Sealed Proposal and Best Value. The design–build delivery system has proven successful in reducing the delivery schedule of a project through overlapping of the design and construction phases, without reducing the time required to complete the individual tasks. It traditionally reduces the project risk for the owner, placing a greater amount of accountability for delays and losses on the design–build contractor. (*55*)

SHA has had a design–build program for unique and trial transportation programs for the past 10 years. Its design–build program only accounts for about 10 to 15 percent of the overall construction program and has been deemed successful so far. SHA normally undertakes two to four design–build projects per year, ranging from large construction projects to guardrail replacement.

SHA began requesting proposals for design–build highway projects in 1998. As of October 2009, 32 highway design–build contracts had been issued, ranging in size from $800,000 to $36 million. This is a 50 percent increase from 2005. None of these projects exceeded the $50 million FHWA threshold set for design–build highway projects. (*56*) Between FY 2000 and 2004, 5.6 percent of SHA's construction dollars went to design–build projects; that number was projected to increase to 17 percent between FY 2005 and 2007. (*57*)

In mid-2004, SHA began a competitive sealed proposal (CSP) pilot program to carry out "best value" selection. Best value is defined by the Design–Build Institute of America as a selection process in which proposals contain both price and qualitative components, and award is based upon a combination of price and qualitative considerations. (*57*)

The interviewed SHA officials have found two challenges in using design–build. The first is securing enough funding to be able to expand the use of design–build. The second is the inherent difficulty in dealing with utility relocation—a facet of construction that requires coordination with and cooperation of independent utility companies and is ideally completed before roadway construction begins.

The ICC is being constructed using design–build contracting methods along with intense interagency collaboration facilitated through leadership in the Secretary's office that ultimately make big exceptional projects like the ICC happen. SHA has experienced much success as evidenced by the construction of this iconic highway that will provide the necessary connections that were envisioned 50 years ago.

Conclusion

MDOT uses its performance measures for budgeting and programming, program management and project delivery, operations, and monitoring results. The increased pressure of having to maintain infrastructure at an acceptable level, greater public accountability, and transparency has challenged MDOT to track its system and continue to improve system performance. With a deliberate effort on environmental stewardship and context-sensitive design, MDOT continues to deliver and attain its transportation goals.

Missouri

A Practical Program of Setting and Meeting High-Performance Expectations

The Missouri Department of Transportation's (MoDOT's) accomplishments in the last decade are prominent. Missouri has gone from ranking the nation's third worst in pavement condition on major roads to the ninth best. Seventy-eight percent of the same roads are in good condition. The Show Me State ranks 17th in overall performance when compared to other state highway systems, and customer satisfaction with MoDOT is 78 percent. (*58*) While most states have seen a decline in the condition of their infrastructure over the last few years, Missouri is one of the few that has managed to improve its transportation system. Despite all this, MoDOT Director Pete Rahn comments that it is not enough. "Great nations build and invest for succeeding generations—like our parents and grandparents did. We have not." (*59*)

Missouri is a large state (17th largest in the nation by population, 21st largest by area), with a population of just under six million. (*37*) About 70 percent of the population lives in urban areas, with most urban dwellers living in either the St. Louis or Kansas City Urbanized Areas. While the state's population is heavily urbanized, urban areas themselves occupy less than four percent of its land area. (*60*)

Missouri has the seventh largest highway system in the country. (*58*) There are over 123,000 miles of public roads in the state. Of that, MoDOT operates and maintains 32,800 miles of state highway. Additionally, Missouri has 10,276 bridges located throughout the state. (*58*) Most public roads are in rural areas—only about 13 percent of statewide roads are located in urban areas. Interstates and principal arterials make up less than five percent of Missouri's road miles, while nearly 80 percent are part of various local road systems. (*61*)

Highway vehicles in Missouri travel around 67 billion miles per year—about the same as in New Jersey (but still the 16th

highest among all states). On a per-capita basis, however, Missourians have the eighth highest VMT in the nation—with each person traveling just under 12,000 miles per year on average. About 60 percent of annual VMT occurs in urbanized areas, with nearly all of that (90 percent) occurring in the St. Louis and Kansas City Urbanized Areas. (*62*) For this reason, metropolitan mobility and congestion are of great concerns to MoDOT.

MoDOT owns and maintains just over 25 percent of statewide public roads. The majority of public roads are county owned, while the rest are nearly all owned by local municipalities. MoDOT has evolved from its creation in 1921 (when the Highway Commission was first created and the agency was led by the chief engineer) to a multimodal agency with over 6,000 employees, governed by an expanded Transportation Commission and led by the director of transportation. The position of director is a relatively new one, having been created in 1999. Also in that year, MoDOT changed its capital funding plan from a 15-year plan to a 5-year plan. Its most recent funding plan (the 2010–2014 State Transportation Improvement Plan) represents a reduction in overall capital funding, with the annual outlay decreasing from $1.3 billion in 2010 to $421 million in 2014. (*63*)

MoDOT's introspective approach to moving forward relies on its ability to focus on organizational results and communicating them internally and externally.

Organizational Structure

MoDOT has as its mission to provide a world-class transportation experience that delights its customers and promotes a prosperous Missouri. Toward that end, MoDOT has taken upon itself to consider as "Job #1" the ability to relate to and understand the needs of the public, as well as to build trust, visibility, and credibility for the agency's actions. However, MoDOT did not always have these goals.

In the 1990s, MoDOT was an underperforming agency that was overcommitted, underfunded, and just emerging from a poorly delivered 15-year capital program. The agency was not respected by state residents, elected officials, or a wide range of partnering agencies. Two changes over the past 10 years have helped turn MoDOT around into a results-oriented entity: (a) In 1999, the position of director of transportation was created and a performance measurement system was initiated. (b) The second change—a major "sea change" according to many MoDOT employees—began when Director Pete Rahn took over in 2004.

With the introduction of the director's position in 1999 came other organizational changes. Most critical among these was the reorganization of front-line units into a complete "system delivery team." The chief engineer oversees this team, which incorporates program delivery, system management, and multimodal operations. For the purposes of this study, program delivery is of most interest, because highway and bridge projects are conceived, analyzed, designed, and built from this area. The director of program delivery oversees these functions, units, and personnel, reporting directly to the chief engineer.

MoDOT has one of the most innovative organizational structures among the states studied. Its organizational chart has three separate wheels for system delivery, organizational support, and system facilitation. Figure 11 illustrates the functions within each wheel.

At the core of each wheel is the outcome that MoDOT's customers expect—tangible results. These are the consequences of a performance measurement system that turns plans into actions and ideas into best practices. The system delivery team focuses on functions related to "Retail MoDOT." This team has direct public contact, supports customer service efforts, and is responsible for the 10 districts of MoDOT. The role of the system facilitation team is to assist the system delivery team to achieve MoDOT's tangible results, supporting functions necessary to maintain operations. The organizational support team provides services to both system delivery and system facilitation teams. (*64*)

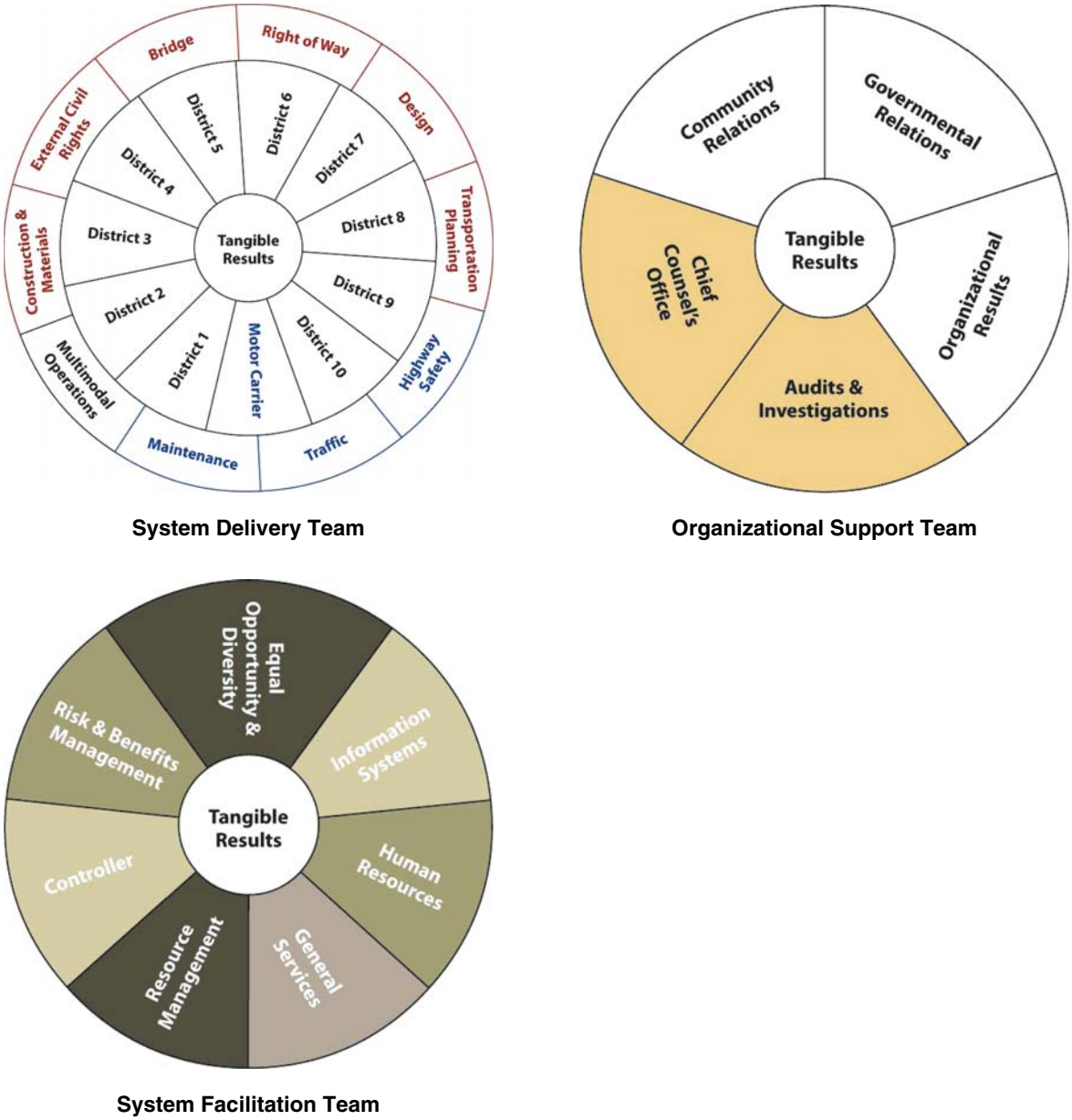
The director of MoDOT is appointed by the governor and confirmed by the state senate. The director does not report to the governor, however, but rather to the Transportation Commission. The commission is independent, has its own set of bylaws, and consists of three democrats and three republicans. This equal number provides a bipartisan balance on all transportation issues, and a sounding board on all capital planning and maintenance projects.

Transformation through Leadership

The success of an agency in overcoming challenges and fiscal constraints is a true reflection of leaders that guide, take risks, and continue to look for innovation in everyday practices. The current MoDOT director encourages risk and the acceptance of failure, but insists that staff complete projects at a fast pace using the right tools.

Over the last five years, a major set of changes have occurred within MoDOT. The Director's mandate that the agency perform at a very high standard set the stage for operational, strategic, and cultural transformations to occur within the department. Under the kind of leadership that has empowered the department, the concept of speedy project delivery has been positively reinforced. As a result, expectations within the MoDOT have been ratcheted up, schedules are being accelerated from the projects' very inception, and, most notably, MoDOT has succeeded in winning back the public's trust. (*65*)

Director Rahn is reported to have helped transform MoDOT into a performance-based agency. New processes have been



Source: Missouri Department of Transportation

Figure 11. Partial MoDOT organizational chart.

proven successful and are predicted to last well beyond his term as Director. In addition, the performance measurement system that was conceived in 1999 has evolved into the *Tracker,* MoDOT's quarterly report on measures of departmental performance. As the January 2009 report states:

> "This document is your window into MoDOT—warts and all. It invites you to hold us accountable for exceeding your expectations. . . . These results guide us every day as we go about the business of delighting our customers. In the *Tracker,* you will see that we have established measures to gauge our progress and we are comparing ourselves to the best organizations in the country." (*66*)

The *Tracker* holds MoDOT staff accountable and is "committed to being open and transparent. We want you to know what we do well, what we don't do so well and what we are doing to get better." (*66*)

Accelerating Project Delivery

A number of specific actions have been implemented to help MoDOT better accelerate delivery of projects over the past decade. Five of them are discussed in the following sections.

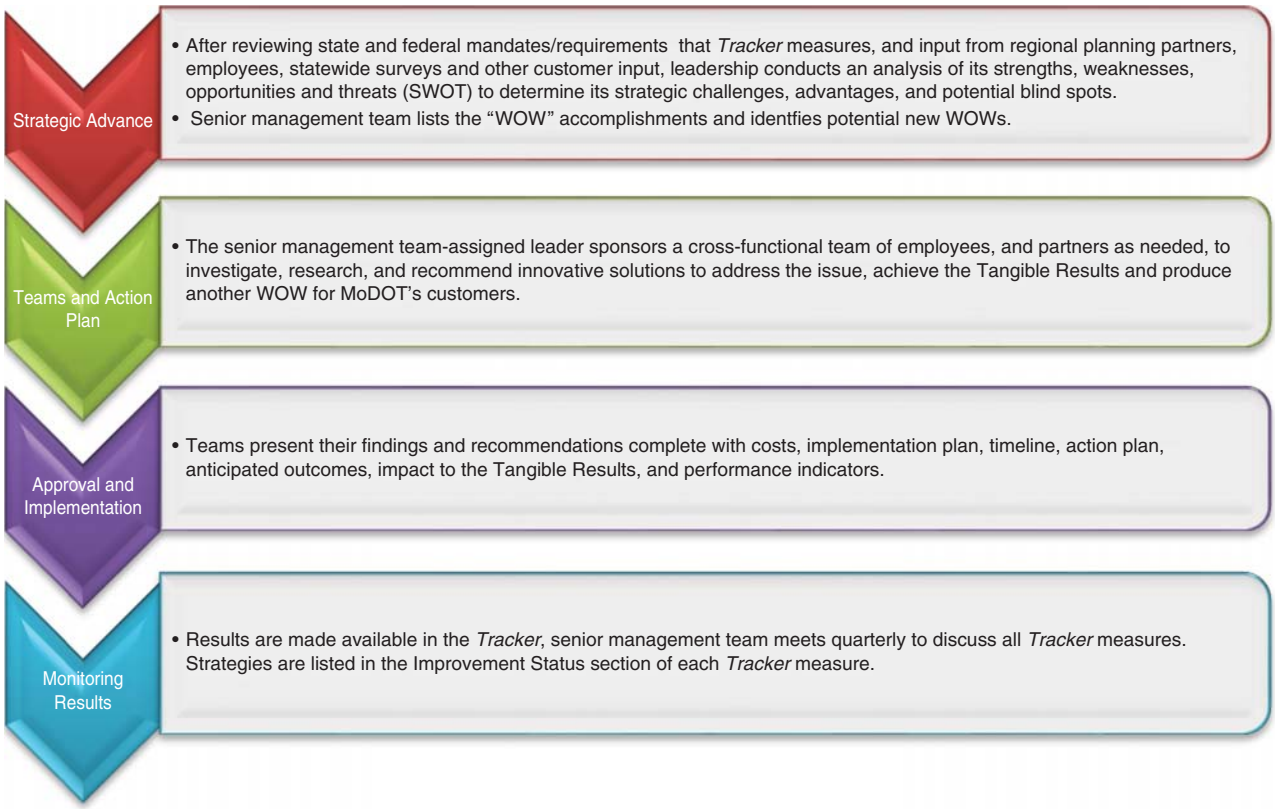
Strategic "Advance"

Every year, a meeting is held among departmental managers to discuss priorities and develop strategies for the upcoming year. An important aspect of this "advance" is to assure that the activities of managers are in line with MoDOT's mission statement and overall policies. This proactive approach contrasts directly with the more commonly used "retreat" terminology, where management looks back at past performance and reacts—often too late—to problems and issues that have gone unaddressed and affected the public's perception of the department. This advance approach seeks to implement actions rather than discuss plans. The Strategic Advance is only the first step to setting and communicating the overarching organizational direction. Figure 12 shows the other steps involved in MoDOT's strategic planning approach that integrates top-down and bottom-up methodologies.

Building and Maintaining Strong Relationships with Other Agencies

Throughout MoDOT, a major emphasis has been placed on developing strong working relationships with agencies at all levels of government in order to better coordinate and expedite important processes and reviews. Some of the critical relationships that have been fostered include the following:

- **Federal Highway Administration:** Many in the agency point to the close working relationship they have with the FHWA as critical to expediting their work. MoDOT is currently working with the FHWA on the "Better Roads, Brighter Future" program. Their involvement has been very helpful. Together, MoDOT and the FHWA have streamlined resurfacing, restoring, and rehabilitation of non-freeway roadways and environmental processes and have reached agreements on design treatments, guardrails, etc. As a result, projects go out to bid faster, are completed under budget, and are saving more lives by being completed sooner. MoDOT's environmental division has enhanced its working relationships with state and federal regulatory agencies, including the FHWA. The FHWA has expressed approval of MoDOT's "planning framework" process, and the two agencies have maintained a close relationship.
- **Missouri Department of Natural Resources:** MoDOT administrators have praised the department's environmental division for developing a variety of staff experts who have established great working relationships with state agencies such as the Department of Natural Resources (DNR).



Source: Missouri Department of Transportation, 2007 Application for the Missouri Quality Award (*64*)

Figure 12. Steps involved in MoDOT's strategic planning approach.

It is fortuitous that MoDOT shares office space with DNR; this co-location has facilitated communication and proven crucial in fostering a strong working relationship with the agency. MoDOT tracks environmental responsibility and takes it very seriously.

- **Metropolitan Planning Organizations and Regional Planning Commissions:** MoDOT districts are customer focused and have strong relationships with Missouri's seven MPOs and nineteen regional planning commissions (RPCs). The department has worked to maintain a professional working relationship with these quasi-governmental agencies. MoDOT has changed its project prioritization process over the past five years. It used to identify needs and projects in its central office, a practice that frequently raised concerns at the local and regional level. MoDOT now has a "planning framework" in place, where each MoDOT district works with its respective MPOs and RPCs to identify needs and build support for projects at a more grassroots level.
- **Contractors:** MoDOT holds quarterly meetings with representatives of the general contracting industry, as well as with specialized contractors who work exclusively in concrete, asphalt, and bridge work. As a result, the industry has been influential in many of the changes that MoDOT has implemented. Their inclusion in the process has built mutual respect, while preserving the owner/contractor relationship. By establishing a dialogue with contractors on a regular basis, MoDOT has learned about making specification changes that are important to the industry but of no consequence to the department. By making these changes, MoDOT has won an ally in the construction industry and made it easier for contractor and owner alike to expedite projects and reduce costs.

  An additional benefit of involving general contractors in quarterly meetings is that they begin to understand that the projects listed in the State Transportation Improvement Plan are real, with three-month locked-in schedules for letting. This knowledge encourages them to gear up for a job and hit the ground running when the project is released for bid.
- **U.S. Army Corps of Engineers:** MoDOT has fostered good relationships with the Army Corps, especially in conjunction with the "Safe and Sound Bridge" program geared toward improving bridge safety.
- **Partnering for Innovative Efficiencies:** MoDOT recognizes that transportation demands are increasing while state revenues are not adequate for construction. A system called the Partnership Development Process has been created to allow other agencies to partner with MoDOT so that innovative financing methods can be developed for transportation projects that serve a public purpose. Partnerships help MoDOT to jointly solve problems, build and strengthen relationships, increase efficiency, develop innovative solutions, and improve coordination. (*67*) Such alliances have accelerated project delivery, which ultimately benefits the citizens. Building with shared purposes—and shared resources—helps offset the cost of building the projects separately, inflation costs stemming from delays, and other financing costs.

Maintaining Core Competencies and Experience

In an era of state fiscal crises nationwide, MoDOT has maintained relatively stable staffing levels over the past decade. In 2008, MoDOT continued to retain a large staff of over 6,300 employees, which has translated into MoDOT's preserving core competencies, even through periods of low funding and workload. It has also enabled individual project managers to maintain responsibility over a project from inception through construction. MoDOT program delivery has been successful because of strong leadership, competent personnel (i.e., the right people in the right jobs), the Transportation Commission's recognition of the staff's hard work, and the system's flexibility.

MoDOT has held its employees accountable to the department's motto: "Working together to achieve the right results." Staff members have reported that personnel are implored to perform. MoDOT leadership prepares managers through the Management Development Institute, which is designed to improve a person's ability to manage people, processes, and results. This ultimately allows managers to take on more responsibility and challenges.

Staff responsibilities and internal cross-training have increased as well. Resident engineers are now required to be familiar with the responsibilities of the construction and materials engineers. One recent example of such cross-training has been demonstrated by sending personnel from throughout MoDOT to see first-hand, the lessons learned from the major I-64 reconstruction project in St. Louis. The knowledge gained has helped employees in the design and construction functions work better together.

Expectations and accountability have not only increased internally; professional consultants are expected to get the job done, and MoDOT terminates those who do not succeed. According to one manager, beginning in 2008, MoDOT has successfully reduced its share of outside consultant procurement from about 35 percent to 5 percent.

A Focus on Purpose and Need

Purpose and need is considered to be a fundamental component of a project during the scoping process. Department management has encouraged DOT staff to be passionate about developing the right scope and budget for projects, with the aim of delivering projects in a timely fashion and

within budget. A poorly defined scope that is broader than the purpose and need will result in higher project costs and lengthy schedules, while a scope that falls short of it will result in a project that does not meet the objective. The complete project scope involves determining the root causes of the need, developing a range of alternatives, and choosing the best solution that considers the cost and delivery time frames. The purpose and need is revisited often and items that do not support it are redesigned, re-evaluated, or eliminated completely. (*68*)

Decentralization and Centralization

Reorganization within MoDOT has involved the judicious use of both decentralized and centralized management—utilizing the benefits of each according to the application and what best fits the organization's mission and goals:

- **Decentralization:** MoDOT divides the state into 10 districts: Northwest, North Central, Northeast, Kansas City Area, Central, St. Louis Area, Southwest, Springfield Area, South Central, and Southeast. These districts are more customer focused and are able to maintain stronger relationships with local and regional governments than a single central office can. This arrangement respects the uniqueness of each district, its geography, its social culture, and its political climate. The decentralized aspects of the organization afford district personnel a measure of autonomy. MoDOT staff is held accountable statewide, however, via the *Tracker* system.
- **Centralization:** The creation of a central system delivery team is widely acknowledged as being critical to the successful acceleration and delivery of projects at MoDOT. Furthermore, creating the position of director of program delivery in the central office has been especially important, making that individual responsible for directing the transportation planning, design, right-of-way, construction and materials, and bridge groups.

Further within the program delivery function, there is a mix of centralized and decentralized units. For instance, design, right-of-way, and construction and materials are decentralized among the 10 districts. Again, when decentralization gets programs and projects delivered faster, MoDOT empowers the district offices to make decisions that move projects forward. MoDOT is prudent with its use of eminent domain, preferring to do mediation over outright taking. Property issues often get resolved at the eleventh hour, which, although frustrating to the affected district, is typically appreciated by the public. This kind of activity is much better administered at the district level rather than from a central office many miles away.

Other functions at MoDOT are predominantly either centralized or decentralized. For instance, a small transportation planning staff is located in each district, although most are located in the Jefferson City central office. Planning staff in the central office deal with many project delivery issues, long-range planning, MPO and RPC oversight, and various departmental management systems. This central group also provides assistance to district planners on policy issues. Community relations staff is located primarily in the districts, supported by some central office functions that provide resources as needed, such as video and photography services. The centrally located bridge division is in charge of all MoDOT river crossings and viaducts. The environmental division is also located centrally, benefiting from its co-location with DNR staff. Some construction and materials personnel/facilities are centrally located as well, including geotechnical experts, laboratories, and some construction and materials engineering staff. However, most (such as inspectors) are located within each district.

Process Management—Integrating Core Competencies

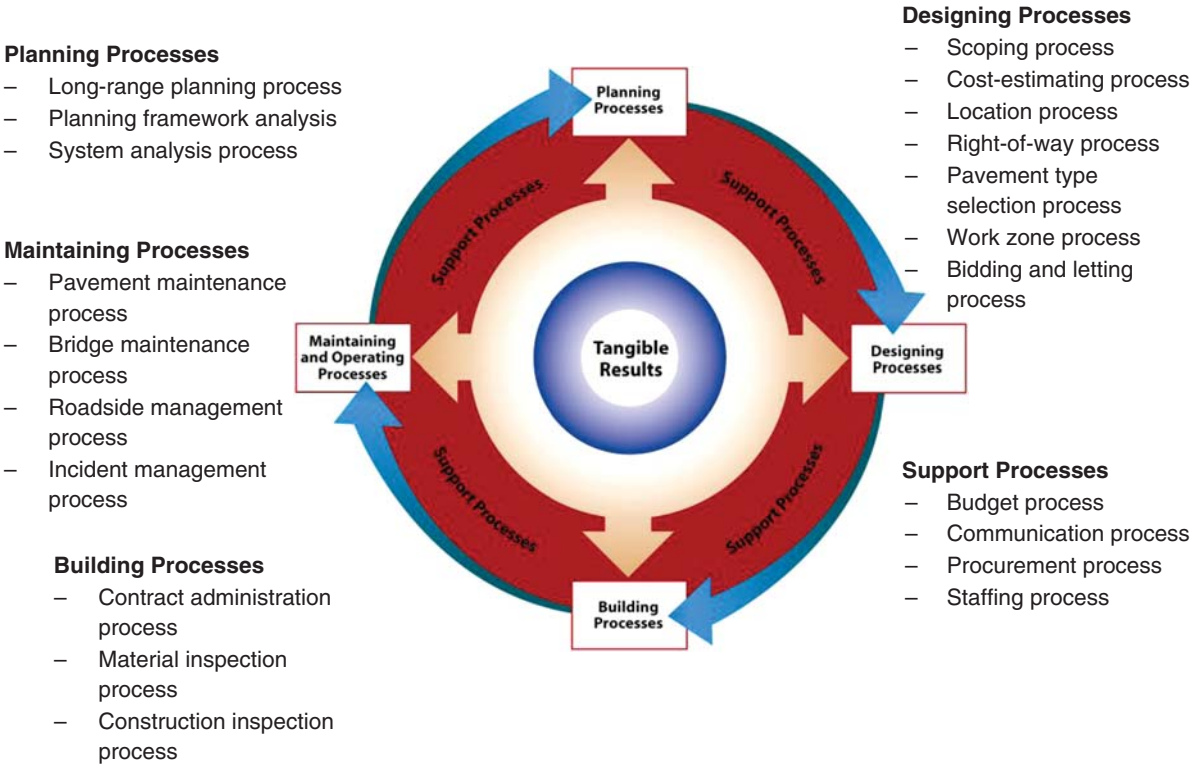
MoDOT's core competency is to develop and maintain the state's transportation system. MoDOT strives to provide the public with a safe, efficient transportation system that delights its customers and promotes a prosperous Missouri. MoDOT delivers this promise through core competencies such as plan, design, build, and maintain (See Figure 13). At the root of these competencies is MoDOT's mission to achieve its tangible results as reported in the *Tracker*. (*64*)

Expanding outward from this core is a myriad of processes that are not only tied directly to the mission, values, and tangible results, but also prescribe the work systems of planning, designing, building, and maintaining. "New technology, organizational knowledge, and agility are built into the processes by setting the focus and allowing empowered employees to manage performance with an eye on measurement indicators." (*64*) Each process has to achieve MoDOT's tangible results. Each process should be timely, efficient, and effective without compromising safety. The processes work together, holistically, to ensure that the state's programs and services for all modes of travel are delivered. And all work processes must be better, faster, and cheaper.

Best Practices for Missouri

Tracker—Measures of Departmental Performance

Organizational effectiveness begins with a total understanding of the mission and values and a commitment to delivering tangible results. The *Tracker* was developed to assess how MoDOT "is measuring up" both internally and externally. For a program that is only four years old, the *Tracker* already has had much success in the results it provides. It has become



Source: Missouri Department of Transportation, 2007 Application for the Missouri Quality Award (*68*)

Figure 13. Work system design and key processes.

the focal point of how MoDOT delivers its programs and projects. The *Tracker* is a system that continuously measures and monitors the tangible results.

The expectations of the public are translated into 18 tangible results:

- Uninterrupted traffic flow
- Smooth and unrestricted roads and bridges
- Safe transportation system
- Roadway visibility
- Personal, fast, courteous, and understandable response to customer requests
- Partnership with others to deliver transportation services
- Transportation leveraged to advance economic development
- Innovative transportation solutions
- Fast projects that are of great value
- Environmental responsibility
- Efficient movement of goods
- Easily accessible modal choices
- Customer involvement in transportation decision making
- Convenient, clean, and safe roadside accommodations
- Best value of every dollar spent
- Attractive roadsides
- Advocacy for transportation issues
- Accurate, timely, understandable, and proactive transportation information

The tangible results measures within the *Tracker* are key indicators that measure MoDOT's organizational effectiveness. For each of these tangible results, there are two to sixteen measures used to evaluate MoDOT's success in attaining those results, as shown in Figure 14. For instance, for the tangible result *environmental responsibility,* seven measures are monitored: (a) percentage of projects completed without environmental violation, (b) number of projects where MoDOT protects sensitive species or restores habitat, (c) ratio of acres of wetlands created to the number of acres of wetlands impacted, (d) percentage of Missouri's clean air days, (e) number of gallons of fuel consumed, (f) number of historic resources avoided or protected as compared to those mitigated, and (g) number of tons of recycled/waste materials used in construction projects. Similarly, the remaining 17 tangible results also have detailed measures that are tracked and reported. The January 2009 *Tracker* lists 112 total measures spread among the 18 tangible results. (*69*) Clearly there is a great emphasis on getting the best value for every dollar invested in the transportation system.

Drivers and Benchmarks

Individual MoDOT personnel are assigned responsibility as "drivers" for the overall tangible result as well as for

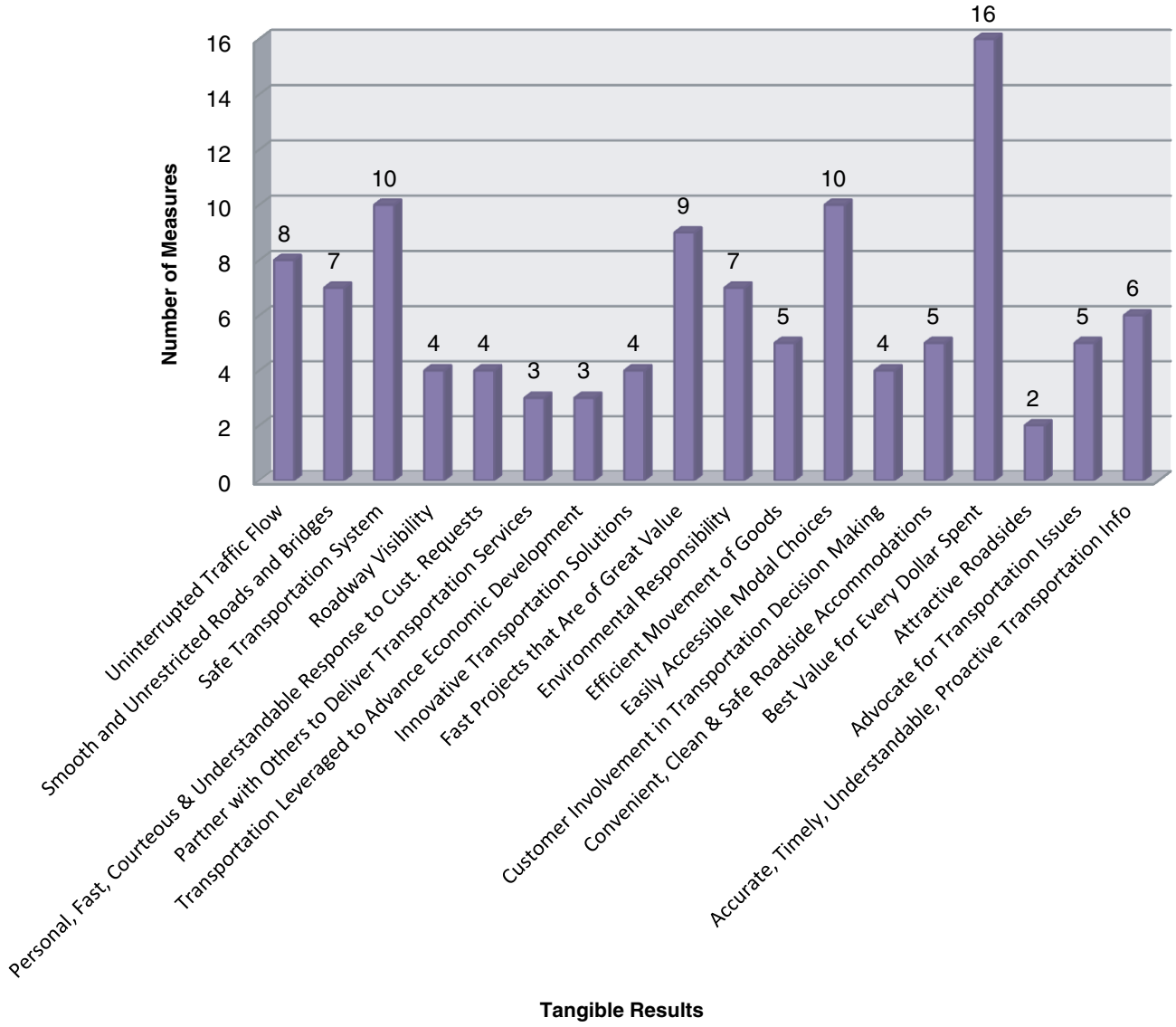


Figure 14. Chart indicating the number of measures used for each tangible result.

each measure. For example, the director of program delivery is assigned responsibility as the driver for the tangible result *fast projects that are of great value,* while the responsibility for "driving" the nine measures of this result is split among five other individuals. What is quite apparent in the MoDOT culture is that they attempt to benchmark every measure in the *Tracker* against the best in class. For *environmental responsibility,* Missouri measures itself against Dallas, Texas; for *best value of every dollar spent,* MoDOT compares itself against Maryland and New Mexico DOTs and the private construction industry; for *fast projects that are of great value,* MoDOT compares itself to Georgia and Michigan; and for *innovative transportation solutions,* MoDOT measures itself against the New York State DOT as the benchmarking organization. (*64*) This practice sets the stage for continuously improving and striving to provide "a world-class transportation experience."

Four of the eighteen tangible results have a direct bearing on expediting projects and programs through MoDOT: *smooth and unrestricted roads and bridges, transportation leveraged to advance economic development, innovative transportation solutions,* and *fast projects that are of great value.* The *Tracker* reports on the status of each of the measures for each tangible result. Using *fast projects that are of great value* as an example, Table 5 shows the level of detail that is measured and monitored on a quarterly basis for each of its nine measures.

Establishing baselines, setting benchmarks, tracking progress, and making adjustments to one's system and processes are challenging tasks. While a number of states track construction costs, few have information on total project costs. Even fewer are able to compare programmed total project cost to final total project cost. While many states can provide qualitative information on how they are perceived by the

Table 5. Measures that track *fast projects that are of great value.*

Measure	Purpose of Measure	Results
Percentage of programmed project cost as compared to final project cost	This measure determines how close MoDOT's total project completion costs are to the programmed costs. The programmed cost is considered the project budget.	As of June 30, 2009, for Fiscal Year 2009, a total of 411 projects were completed at a cost of $1.593 billion. This represents a deviation of 0.31 percent or $5 million more than the programmed cost of $1.588 billion.
Average number of years for a project to go from the programmed commitment in the Statewide Transportation Improvement Program to construction completion (from 2006 to 2007)	This measure monitors how quickly projects go from the programmed commitment to fiscal closure of a construction project.	Design time for resurfacing projects: down to 0.7 yr. Design time for safety projects: up to 1.3 yrs. Design time for major bridges: down to 1.5 yrs (from 4.3 yrs) Design time for new or expanded highways: up to 3.9 yrs
Percentage of projects completed within programmed amount	The measure tracks the percentage of projects completed within the programmed amount. It includes separate categories for projects over and under $1 million.	In Fiscal Year 2009, 60 percent of projects programmed over $1 million were completed within the budgeted amount, while 54 percent of projects under $1 million came in at or below budget.
Percentage of projects completed on time	This measure tracks the percentage of projects completed by the commitment date established in the contract.	93 percent of projects completed in fiscal year 2009 have been on time.
Percentage of change for finalized contracts	The measure tracks the percentage difference of total construction payouts to the original contract award amounts.	MoDOT's performance of 1.1 percent in fiscal year 2009 is below the target of 2 percent.
Average construction cost per day by contract type	This measure tracks the cost per day for project completion to determine the impact to the traveling public, enabling MoDOT to better manage project completion needs.	The greater use of A+B and calendar-day contracts resulted in a larger amount paid per calendar day in the first three quarters of Fiscal Year 2009.
Unit cost of construction expenditures	This measure tracks how MoDOT projects provide great value by comparing the cost of major items of work for MoDOT projects to other state DOTs.	Excellent competition in the past year has enabled MoDOT to realize almost a 7 percent reduction in unit prices for bridge construction—the second largest percentage decrease in this area among Missouri's surrounding states.
Annual dollar amount saved by implementing value engineering (VE)	This measure tracks the amount of money MoDOT saves by implementing value engineering proposals.	In 2008, MoDOT design savings from VE studies were $96.1 million, a 94 percent increase from 2007. So far, for 2009, design savings are $23.5 million.
Percentage of customers who feel completed projects are the right transportation solutions	This measure provides information regarding the public's perception of MoDOT's performance in providing the right transportation solutions.	The majority of respondents thought that the project made the roadway safer (95.4 percent), more convenient (91.2 percent), less congested (82.7 percent), easier to drive (94.2 percent), and better marked (92.3 percent) and was the right transportation solution (94.7 percent).

Source: Missouri Department of Transportation, *Tracker*. Measure of Departmental Performance, July 2009

public, MoDOT provides a percentage of overall customer satisfaction, or the percentage of customers surveyed that feel that MoDOT takes into consideration customers' needs and views in transportation decision making. In effect, each tangible result is backed by a baseline of where it was and a benchmark of where it is currently. Very few states have gone to such lengths to gauge themselves and then inculcate expectancies to raise the bar.

Whether the trend is toward a positive improvement or a negative result, each tangible result driver has the responsibility—and the challenge—to meet the baselines previously set and/or exceed the established benchmarks. The *Tracker* is an excellent tool for short-term action planning. Based on the data collected for each measure every quarter, managers have the ability to change or modify their strategy if the trend for the tangible result is not headed in the desired direction. As such, constant improvement, continuous monitoring, and balancing of priorities occur so that the results expected by the customers/public are delivered—almost in real time.

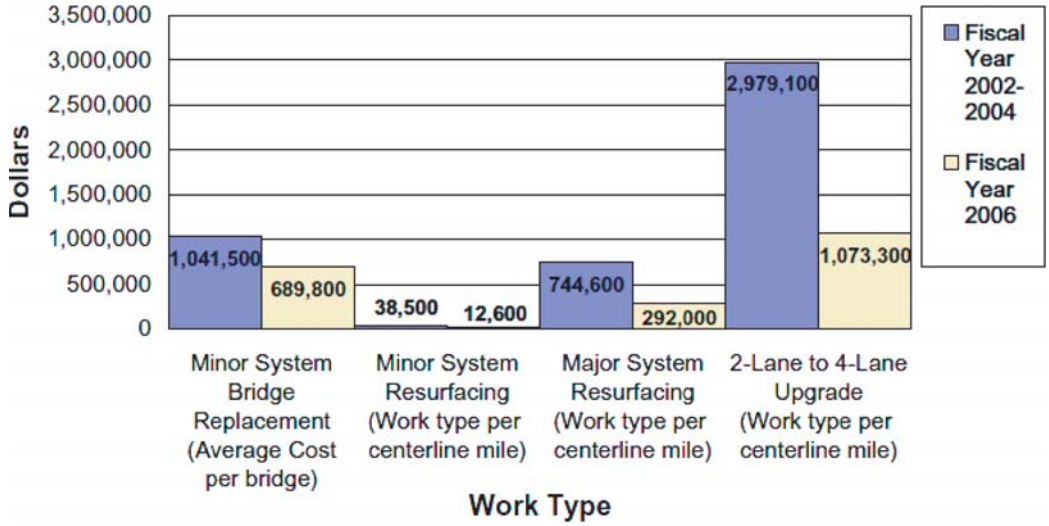
Practical Design

Nearly everyone interviewed at MoDOT talked about the move toward "Practical Design" solutions as an important, positive step in the project and program delivery process. The concept was introduced at MoDOT in 2005 and was documented later that year in a Practical Design Implementation Manual. In the first two years, Practical Design saved Missouri taxpayers $400 million. (*70*) As both MoDOT and the American Council of Engineering Companies of Missouri have stated, "State DOTs must deliver the transportation system better, faster, and cheaper than ever before. MoDOT's Practical Design effort accomplishes that goal by building 'good' projects everywhere instead of 'perfect' projects somewhere." (*19*) In a similar vein, MoDOT Director Rahn stated that Missouri engineers design highways aiming "not to build perfect projects, but to build good projects that give you a good system." (*71*)

The concept of Practical Design involves looking at projects on a case-by-case basis, rather than following the strict guidelines and parameters of a project. In other words, a road might be built to a lower standard than would be the case if funds were unlimited, but still meet the purpose and need and basic requirements. Safety, however, is never compromised in this equation.

Critical aspects of Practical Design as practiced by MoDOT include properly defining the scope by focusing on meeting the purpose and need, while considering the surroundings of each project (*adequately* meet purpose and need *without* unnecessarily *going beyond),* getting the best value for the least cost, never compromising safety, and collaborating on the solution. (*68*) An example of a Practical Design solution was to use an 8- or 10-inch pavement thickness instead of 12 or 14 inches of concrete as was done in the past. By using non-traditional design methods or newer construction products and materials, and different techniques, MoDOT transportation officials have been able to deliver system-wide improvements while saving funds that were being wasted in over-designed items. Figure 15 shows the dollar savings from Fiscal Year 2002 to 2006 though MoDOT's implementation of Practical Design.

MoDOT encourages innovation and creativity among its staff to accomplish the goal of implementing Practical Design. There is also a powerful incentive to institute Practical Design



Source: Missouri Department of Transportation, MoDOT's Approach to Program Management (*68*)

Figure 15. Dollar amount saved by implementing Practical Design.

at MoDOT: If a districts' project comes in under budget, the savings are returned to that district for future projects under its purview. At the same time, if projects come in over budget, the money is taken from the overall district budget.

Conclusions

MoDOT is doing much to accelerate project and program delivery. The Missouri *Tracker* sets the organizational strategic goals and direction, while Practical Design is one of the tools and methods of doing business to accomplish tangible results. Other salient points observed at MoDOT are summarized in the following sections.

Committed Leader

There is no way to overestimate the impact that the current director of MoDOT, Pete Rahn, has had on the department's commitment to accelerate projects and quickly create a great transportation system in Missouri. In the five years that he has served, there appears to have been a significant internal shift to high performance for the benefit of the state's taxpayers, as well as a perception outside the agency that a positive transformation has occurred. Perhaps the greatest compliment to the director's role in creating this environment was the MoDOT official who felt that the informal and formal changes implemented by Rahn would last well beyond his tenure as director. Values such as honoring commitments, appreciating diversity, fostering a caring workplace, being responsive and courteous, encouraging risk and accepting failure, empowering employees, and innovative decision making are practiced by senior leaders and filtered down throughout the organization. Essentially, the director has succeeded in achieving total organizational buy-in for MoDOT's mission.

Strong Reliance on Staff

In an era of shrinking state DOT staffs, Missouri seems to have bucked the trend. Not only has there been an effort to retain staff and competency levels, but there has been a move to help employees develop new skills and foster new working relationships and to refocus them toward delivering projects, meeting performance goals, and acknowledging customer needs and viewpoints.

Coordination and Communication Are Critical

It is a major department-wide goal to improve and maintain communication and coordination with the wide range of partners MoDOT needs to engage in order to effectively deliver its projects and programs. The communication begins internally, as managers and staff share best practices, progress, and issues through formal and informal channels. It extends to the host of federal, state, regional, and local government agencies involved at all levels of project development and delivery. It involves contractors. And it extends to the general public.

Innovative Design Practices

MoDOT, like several other state DOTs, has engaged CSS concepts in its design processes through the development of Practical Design policies and manual. What seems particularly unique in MoDOT's application of CSS is the clearly stated desire and sharp focus on delivering more "good enough" projects better, faster, and cheaper, with the end result being a great statewide transportation system.

Emphasis on an Open and Clear System of Performance Measures

The *Tracker* has evolved quickly into an important departmental tool for measuring MoDOT's overall performance, including its ability to accelerate projects and programs. Its measures are both clear and results oriented. Champions of each measure are named and therefore clearly identifiable, internally as well as externally to the public. The *Tracker* is published quarterly, to facilitate better judgment of trends and provide time to adjust strategies in performance. It measures present-day effectiveness against past trends. Most important, it is a tool that is of equal importance to effectively managing MoDOT and its various responsibilities, as well as building credibility among Missourians about how their transportation system is performing. This "public window" via web access is the greatest testimony to MoDOT's efforts toward transparency.

MoDOT has experienced a cultural shift in the last five years. Beginning with the *Tracker* and Practical Design, both of which were implemented in 2005, these strategies are designed to exceed customer expectations, maintain accountability, and continuously improve quality. A focus on turning ideas to reality and implementing best practices to produce results, while striving for innovation and radically controlling costs, has done much to speed its programs and projects from conception to completion.

New Jersey

Pipelines to Project Delivery

The New Jersey DOT's mission statement is "Improving Lives by Improving Transportation." This motto is one that challenges the New Jersey DOT (NJDOT) in its efforts to improve its aging infrastructure and roadway networks that commuters have come to depend on. NJDOT's philosophy begins with addressing the critical goals and objectives of

safety first, fix it first, congestion relief, smart growth, intermodal efficiency, environmental/quality of life, and economic development opportunities. (*72*)

New Jersey's state highway system consists of approximately 38,000 centerline miles of roadways, of which the DOT owns and maintains approximately 2,344 miles. The remaining roads fall under county and municipal jurisdictions. Although NJDOT manages only 6 percent of the roads, about 67 percent of all traffic, including heavy trucks, use these state-owned roads. A recent measure of state roadway roughness and distress measurement indicates that approximately 49 percent of the state's highway system is deficient. (*72*)

With a population of approximately 8.7 million, New Jersey is the most densely populated state in the nation. Surprisingly, this urban environment has only six urban cities with more than 100,000 people, based on a 2004 estimate. (*29*) New Jersey's geographic location in the Northeast Corridor, its immediate proximity to New York City, and major economic generators and industries—such as ports, airports, warehousing, and pharmaceuticals—generate high volumes of commuter, freight, and recreational traffic. These volumes place a huge burden on the roadway system to carry ever-increasing amounts of everyday traffic.

More telling is the number of VMT on state roads. New Jersey experiences 75 billion VMT annually on federal aid highways. (*72*) When compared to other Northeast Corridor states, New Jersey also has the most densely traveled lane miles. The wear and tear of daily traffic, the multiple freeze–thaw cycles of the temperate winter climate, and heavy truck traffic cause pavement surfaces to deteriorate more quickly than states in other locations. Transportation professionals in New Jersey have the unique challenge of finding ways to deliver projects amid fluctuating climatic conditions, limited space requirements, and the increasing heavy truck traffic that passes over New Jersey's roads and interstates to get to their destinations.

Apart from the aging infrastructure, New Jersey also faces problems with congestion. Despite the increase in population and employment, New Jersey has recognized that it "cannot build [its] way out of congestion" and must instead look to innovative solutions and practical approaches to address its transportation needs. Fourteen percent of the roads operate at or over capacity. Congestion in New Jersey is no longer reserved just for peak hour traffic; pockets of urban New Jersey's roads experience congestion lasting more than one hour, and experience increasing delays at other bottlenecks and intersections. (*72*)

State funding for New Jersey in 2006 came from a variety of sources including user tax revenues, road and crossing tolls, general funds, bond proceeds, the federal government, and other miscellaneous income. Total receipts amounted to $4.9 billion. Disbursements were allocated to the national highway system, roads and streets, maintenance and highway services, interest, bond retirement, grants, and local aid. Total disbursements amounted to $3.8 billion. (*72*) However, it has been estimated that approximately $7 billion is required to bring the state's deteriorating infrastructure to acceptable standards.

Roads and bridges that were designed for the 20th century have outgrown their useful life and must now be upgraded or rehabilitated to 21st century standards. According to NJDOT's discussion group, limited revenue resources along with competing demands do not provide the necessary funds and tools to restore and rebuild New Jersey's infrastructure needs. The new mode of operations currently in place at NJDOT is focused on rehabilitation and maintenance of existing infrastructure.

Organizational Structure

The NJDOT has always had a predominantly centralized organizational structure. It is a tiered structure wherein the commissioner provides leadership to his or her subordinates. Under the deputy commissioner, assistant commissioners, along with directors and program managers, address the DOT's organizational and operational issues. Directors, program managers, department heads, and regional managers all provide direction and guidance in their respective areas to deliver their short-range and long-range programs and projects. The three major areas under the deputy commissioner that contribute to program delivery are (a) Planning and Development, (b) Capital Program Management, and (c) Operations. Of these, Capital Program Management lies at the heart of project delivery.

NJDOT has satellite offices and maintenance facilities located throughout the state, but all major decisions are made from the central office in Trenton. Centralizing all offices and units in one location has allowed for better communication, not only within different units but also with external stakeholders. While the organization is somewhat vertical, there have been many internal changes resulting in a flatter and more horizontal approach to reduce the formalities inherent in "tall" organizations.

Internal Reorganization

NJDOT has also gone through several internal reorganizations. However, reorganization did not simply occur on one level. At the macroscopic level, there were global changes within NJDOT that allowed the department to move from long-duration, high-development cost to lower cost and higher efficiency in project delivery. These overarching elements of reorganization involved a pipeline approach to project delivery, capital investment strategy, and a management-by-objective approach. At the microscopic level, fine-tuning of community

partnering, agency partnering, and task order contracts has helped to expedite projects.

NJDOT's reorganization involved restructuring where certain functions were handled. For instance, environmental documentation was only initiated in the Division of Project Management (DPM) after an initially preferred alternative was selected in the Division of Project Development (DPD). Not only did this entail an official handoff from one unit to another, but critical time was also lost in the ramp-up efforts to gain an understanding of the initially preferred alternative and the preparation of environmental documentation. At each phase, a new group of individuals would have to familiarize themselves with the history, project data and information, decisions, stakeholders, and particular challenges of the project. Often, decisions made by the DPD were questioned by the DPM, and projects would either take longer to advance or additional effort would be required to move the project forward. Some of this effort involved rework and a resulting loss of time and budget. In an effort to streamline the environmental process, activities related to environmental documentation were brought into the development phase of the project. This way, the environmental process could start sooner in the project's life cycle, with other tasks being performed concurrently, and remain with the same individuals who were involved in the earlier decision-making process.

Prior to the reorganization, the Office of Access Design and the Major Access Permit unit were under the Division of Design Services. Managers found that many access functions had a direct impact on right-of-way, which would then impact project delivery. These units were relocated under the Division of ROW, which functions under the Capital Program Management area. This relocation bridged the gap between ROW and access functions and caused some of the ROW acquisition processes and access alteration processes to be streamlined.

Project Management Philosophy

Reorganization within the Capital Program Management area also involved a more critical step toward changing the way projects were delivered. Approximately 12 years ago, NJDOT began making the change toward a project management–based philosophy. This philosophy provided guidelines for project managers in terms of how projects should be initiated, planned, executed, controlled, and closed, requiring the Capital Program Management area to undergo a paradigm shift in the way projects were being delivered. The phases of a project (planning, design, and construction) were analyzed for redundancies and potential areas where time was being lost in the project cycle. Reorganization of that area transformed project phases, causing it to take a more unified approach in delivering projects. Using a management-by-objective approach, projects were scoped to have realistic objectives. Those objectives were periodically evaluated and monitored.

The project management philosophy introduced a different way of delivering projects. The concept of the triple constraints—a balancing of scope, schedule, and budget—became a code that project managers lived by. Project managers became more aware of their role in integration management and the importance of such things as project charters, project management plans, and change control procedures. A greater emphasis from upper management on managing scope and maintaining schedules guided the project managers to deliver projects in an organized manner.

The push to move toward a project management philosophy met with some resistance initially. But the philosophy takes this into account and provides a holistic acceleration approach from the initiation of a project to its end. More important, through the project charter, a formal recognition of the project allowed the project manager to begin work, assign resources, make decisions, and orchestrate a plan that provided an end product for users. Not only did the project management philosophy change the way NJDOT did projects, but it also aligned programs with the department's overall business goals; ergo, the need for a formal process to manage projects was established.

Consultant Continuity to Expedite Project Delivery

NJDOT has significantly reduced its staff from 6,000 to only 3,000 employees in the last 10 years. This staff reduction has affected the way programs and projects are processed. To meet the demands of programs that need to be delivered on an annual basis, NJDOT frequently procures professional consultant services. Consultants are brought on board to perform concept developments, feasibility assessments, environmental documents, design, and construction services. Often, a consultant's expertise becomes valuable when the department looks to research and develop a new program or process as well. One of the challenges that New Jersey faces with a reduced work force is maintaining a wealth of knowledge (of the organization) that is tacit and transactive at the same time.

More recently, the NJDOT has taken a step forward to expedite project delivery through the implementation of qualification-based consultant selection in batches and the use of consultant task orders for simpler projects of similar scope. This initiative has eliminated the downtime between project phases and enhanced the department's procurement management practices.

In the past, a qualification-based consultant selection was performed for each separate phase of a project, regardless of its scope. For instance, one consultant might have been respon-

sible for the feasibility assessment phase of a project, while a different consultant would undertake the design phase. Over its life cycle, the project might have passed through three or more different consultants. From the NJDOT end, this process required additional administrative time and effort to prepare RFPs and select consultants. At the consultant end, ramp-up efforts were required when a new consultant was selected for the next phase of the project.

To provide better continuity, the new consultant solicitation process incorporates language that allows one consultant to take the project from inception to completion, from purpose and need definition through to final design and construction services. It permits a contract to be modified such that the same consultant may remain assigned to the project through multiple phases, at the request of the department, without needing to undergo additional consultant selections. Therefore, the DPD has the ability to select a consultant from a group of qualified consultants and subsequent divisions can allow that consultant to perform all aspects of a project. The intent is that one consultant can provide continuity from beginning to end, reducing administrative time in responding to preparing proposal documents and allowing for seamless continuity through project phases. Another key element of maintaining one consultant through the life of the project is that it allows for a better knowledge management system. In other words, critical information and knowledge that is acquired as a project gains momentum is less likely to be lost if the same team of individuals is involved from beginning to end.

Best Practice for New Jersey: Pipelines to Project Delivery

Propelling a project forward through critical milestones and a multitude of activities is possible if the right components are in place throughout the life of the project. Pipelines to project delivery have helped NJDOT achieve just that. "Pipelines" are customized paths that facilitate and ensure that all the elements required for project delivery are addressed from the onset of purpose and need assessment through construction. There are four different pipelines, each representing a different level of project complexity and common characteristics. Pipeline 1 is the most complex pipeline; projects in this pipeline require a purpose and need, environmental documentation, a full feasibility assessment, and preliminary and final design. Pipeline 2 projects are those that qualify for a Categorical Exclusion, with less intensive purpose and need and feasibility assessment work. Pipeline 3 projects require minimal or no work on ROW issues and are relatively simple in scope. Last, Pipeline 4 projects are the least complicated and are usually delivered by in-house maintenance and operations staff.

Pipeline History

The pipelines concept came about in the late 1990s. It was the result of numerous NJDOT units coming together to find ways of streamlining project delivery from its inception. Prior to this time, projects had their beginnings in a Regional Design Office of the Division of Design and ROW and were then transferred to a centralized Environmental group. This unit would perform environmental screening and implement the NEPA process to secure the necessary environmental documentation. The project would be transferred once again to the Project Management group for design. A final transfer would occur when the project was let and entered the final phase, construction. However, in the initial attempts at acceleration, depending upon the complications and challenges of a project at any point in the cycle, the project had the tendency to slow in momentum because of scope changes, to be reprioritized due to funding, to be "thrown" back into DPD possibly due to fatal flaws or insufficient assessments, or simply to be halted due to stakeholder opposition. All of these factors contributed to increased budgets, hours of rework, and delayed project delivery. Management wanted to eliminate those pitfalls and provide a fluid process whereby projects could consistently follow a path to completion.

Through years of refining their existing processes, the four pipelines were created and redefined to provide a clear path to plan, develop, design, and construct transportation projects from the time that an issue is simply a problem statement. These pipelines are now a fundamental way for projects to follow a defined process, build on the basic information and data, and gain momentum as they pass through the multiple phases of concept development, feasibility assessment, design, and finally to construction and completion.

Capital Projects Procedures

The pipelines are a part of a larger set of Capital Projects Procedures (CPP). The CPP serve as a guide that allows NJDOT staff and design consultants to follow a consistent set of steps to produce the best product—a safe, efficient transportation system. Given that the execution of projects requires practical engineering judgment, the CPP is flexible enough to allow for changes. Both NJDOT staff and consultants have some authority to seek changes that eliminate wasteful steps, reduce cost, or even add steps without an undue increase in time, as long as legal issues and regulations are met. (*73*) Inasmuch as the guide provides an organized flow of activities that move projects forward, it allows all participants working on a project to have the same understanding and expectations of how the project will advance step by step.

NJDOT broadly defines five critical phases of a project: screening, purpose and need (PN), feasibility assessment (FA),

design, and construction. Projects that are simple, that require little or no ROW acquisition, which have minimal potential for community concern, and those that are eligible for programmatic approvals can bypass the PN and FA phases. These types of projects are typically limited in scope so they can proceed directly into design and construction. Other projects are screened and entered into an appropriate pipeline for development and execution.

Front End of Pipelines

Before a project enters a pipeline, some front-end preliminary work has to be performed to analyze the problem statement and assign the appropriate pipeline. The Capital Programming and Funds Management unit receives problem statements and evaluates them using a two-tiered screening process. Overall, problem statements are evaluated based upon the Capital Investment Strategy, funding constraints, and other factors that may be influential to the problem statement.

Tier 1 Screening. The Tier 1 screening uses information available and collected by the Management Systems Committees as well as information generated by other sources. Taken together, the coordination and analysis conducted by the Capital Investment Strategy process along with the management systems information serve to inform the selection of an appropriate pipeline for the problem statement. If a problem statement is targeted for Pipeline 1 or 2, it will also undergo a Tier 2 screening. Problem statements that have the potential to advance through Pipeline 3 or 4 are reviewed to ensure that a Tier 2 screening is not required.

Tier 2 Screening. A Tier 2 screening is conducted by the DPD. Such screening identifies and assesses any other needs within the project limits. Because Tier 2 screenings are more detailed and involved, a technical assessment in the field may be required, additional in-house subject matter experts may be enlisted for their expertise and opinion, and community officials may be contacted to obtain a better understanding of the problem statement. "A prioritized, hierarchical recommendation is made that identifies the quickest, most streamlined path that a proposal could reasonably follow after compilation and assessment of the needs, and will sort the [problem statement] into the appropriate project pipeline." (*73*)

Tier 2 screening reports are short-term studies performed on potential project locations that help the Capital Program Committee make decisions on a series of issues regarding the potential project. Decisions regarding the selection of the appropriate pipeline revolve around the following issues:

- Identification of any other needs in the project vicinity, which may not have been addressed in the original problem statement
- Assessment of any additional needs that may have been uncovered and a determination of whether those needs should be addressed at the current time or suspended for future action, or to spin them off as separate problem statements
- Identification of project limits
- Field visit findings
- NJDOT staff coordination
- Results of environmental screenings—the Bureau of Environmental Project Support is requested to review the potential project scope. It determines whether its involvement is necessary based on issues regarding hazardous waste, air and noise, and other environmental impacts.
- Public involvement concerns
- Context-sensitive solutions issues/opportunities

Recommendations resulting from the Tier 1 and Tier 2 screenings define the priority for advancement of the project, limits of the project scope, pipeline path, and anticipated NEPA classification. Pipeline 1 and 2 projects typically require purpose and need as well as feasibility assessment. Results and recommendations provided by the Bureau of Environmental Project Support and the Office of Community Relations play a significant role in determining the pipeline assignment. (*73*)

Tier 2 screenings are more involved than Tier 1 screenings and suggest the quickest, most streamlined path that a project could follow to bring it to construction. This suggestion could result in additional sub-projects that may potentially follow different pipelines. After a Tier 2 screening is completed, the project may follow either Pipeline 1, 2, 3, or 4 or it may be withdrawn completely from NJDOT responsibility and reassigned to local, MPO, or toll road authority; recycled into the project pool for reassignment in later years; or terminated altogether. A Tier 2 screening does not ensure that a project will be advanced.

Management Systems Input

Both Tier and 1 and Tier 2 reports look to internal data repositories to collect information on congestion, pavement condition, safety, drainage issues, maintenance, and rock fall hazards. Management systems that are continually maintained and updated for certain conditions on transportation facilities across New Jersey are listed below (*73*):

- Congestion Management System
- Pavement Management System
- Bridge Management System
- Safety Management System
- Drainage Management System
- Maintenance Management System
- Rock Fall Hazard Rating System Underground Strata

These databases provide relevant information on which some preliminary decisions can be based. For instance, a problem statement regarding the improvement of an intersection is evaluated for the level of congestion, safety issues, pavement conditions, drainage concerns, and other factors that the intersection has. These factors are weighed against and among the factors of other problem statements. This comparison allows the severity of the problem statement to be ranked. An intersection may rank high for level of congestion but have little or no adverse pavement conditions. Other problem statements may concern potential projects with serious safety threats as well as poor drainage conditions. Ranking the problem statements on a system-wide basis using a consistent set of parameters identifies which problem statements are most in need of attention.

Capital Program Committee—"A Good Layer of Bureaucracy"

The Capital Program Committee (CPC) stands as an intermediary or a last step for projects selected for advancement to a pipeline. This committee provides a "check and balance" to ensure that the projects selected for advancement by the Capital Program Screening Committee include the right project scope and enter the right pipeline. Without CPC approval, a project cannot proceed to any of the four pipelines. Even "anticipated NEPA classifications" are contingent upon CPC's approval. (*73*)

The DPD seeks approval from the Capital Program Screening Committee. Management approval is important regardless of the pipeline or path that is selected for a project. This approval aids the DPD and project manager in securing the support units that help to expedite project delivery.

Beyond the task of approving projects to enter pipelines, the CPC is also responsible for decisions related to ongoing projects. Existing projects that require formal changes in scope (increase or decrease) and allocation of additional funds are reviewed by the CPC. As such, according to one manager at NJDOT, the CPC provides "a good layer of bureaucracy" to ensure that funds are spent wisely, using "the right treatment, at the right time, at the right place, and at the right cost." This approach allows the NJDOT to appropriately use available funds, taking into consideration timing, treatment selection, and priority locations.

Propelling through the Pipelines

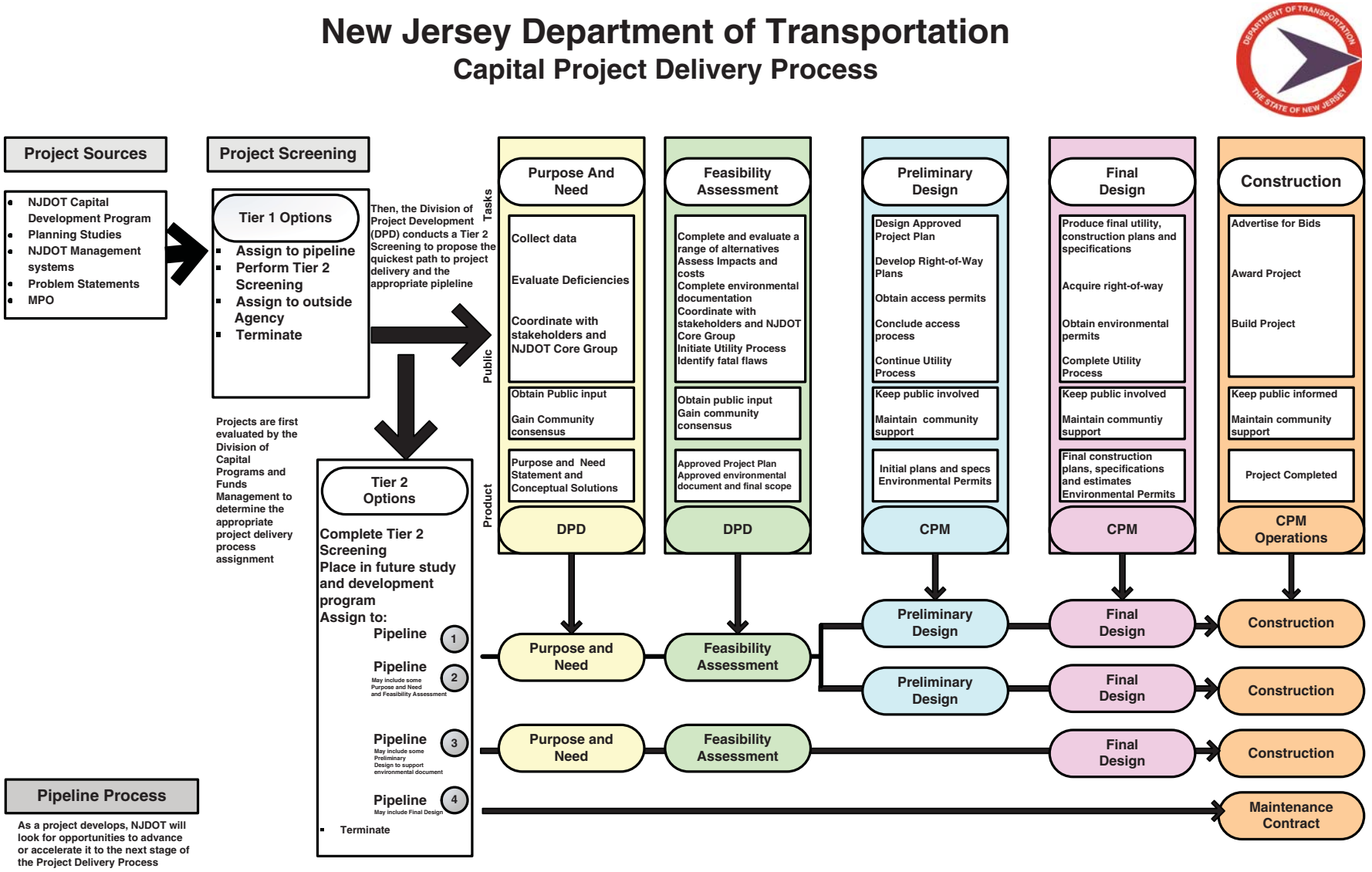
Pipelines are customized to differentiate one pipeline from another. Projects are accelerated through pipelines because they offer a direct, precise set of tasks and activities based on the complexity and characteristics of a project. For instance, a complex bridge construction project that has environmental concerns must account for those activities that address the environmental documentation and permitting aspects of the project. The pipeline it is assigned to must address those activities in a logical, sequential manner so that all key tasks are identified and performed. A simpler resurfacing project would not require the multitude of activities inherent in a bridge construction project, and thus could be simplified to include only those tasks required for a less complex project. For this reason, multiple pipelines were established to allow the simpler projects to bypass the elaborate, complex process required by larger projects. Figure 16 shows the process flow diagram of the project delivery process.

The pipelines offer a template of activities that can be further customized to fit the needs of each project. No two projects are the same, so they are not handled with a "cookie cutter" approach. The pipelines provide a dual advantage: they offer project managers the flexibility to be selective in the tasks that are performed for each project, while providing a controlled guideline of activities to follow for project delivery. While the key elements of a pipeline remain the same, minor tasks can be modified to allow a project to move at a quicker pace. For example, a Pipeline 2 template may outline up to three briefings of community officials as a general rule, but a project manager may feel that only two are required to resolve the issues concerning the community. Simply removing the third community officials briefing from the schedule could accelerate the project by up to three months. Such small adjustments to and fine tuning of the pipeline tasks by the project managers and consultants allow for more expedient project delivery. Conversely, FHWA review and other agency-related tasks may be less easy to adjust and project managers must work within the framework of their standard time frames.

The four pipelines that NJDOT has established are discussed in the following paragraphs.

Pipeline 1: Full Purpose and Need/Feasibility Assessment/ Preliminary Design/Final Design Pipeline Process. This is the most complex pipeline. Projects in this pipeline require extensive purpose and need definition followed by a feasibility assessment. Additionally, Pipeline 1 projects are likely to involve the preparation of an Environmental Impact Statement or at the very least an Environmental Assessment as opposed to a Categorical Exclusion Document. At the conclusion of the feasibility assessment and environmental documentation, the project advances to the DPM where it continues through the pipeline with activities related to preliminary and final design. (*73*)

Pipeline 2. This pipeline includes projects that are classified as Categorical Exclusions under NEPA. Through a screening process, these projects do not require extensive PN or FA work. PN efforts include only a fatal flaw analysis and sufficient



Source: New Jersey Department of Transportation, http://www.state.nj.us/transportation/capital/pd/pdf/CPDProcess.pdf

Figure 16. Flow diagram of the NJDOT project delivery process.

engineering work to establish a scope for preliminary design. The PN statement also includes an analysis of ROW and utility involvement. Examples of projects that enter Pipeline 2 typically include, but are not limited to, the following:

- In-kind bridge replacements
- Bridge rehabilitations
- Simple intersection improvements
- Drainage projects
- Roadway resurfacings
- Safety upgrades
- Operational improvements

Pipeline 2 projects typically require ROW acquisitions in fee or easement. They may also include projects that require a Section 106/Section 4(f) Alternatives Analysis (AA). For example, projects that involve replacing historic bridges and other projects that have Programmatic 4(f) impacts usually enter this pipeline. The AA work on these projects may be detailed but normally follows a very predictable scope of alternatives. (*73*)

Pipeline 3. This pipeline includes projects that have minimal or no ROW concerns. They often meet the criteria for a Certified Categorical Exclusion. Pipeline 3 projects must also have a finding of "No Effect" on any Section 106 resources. Examples of Pipeline 3 projects include, but are not limited to, the following (*73*):

- In-kind bridge superstructure replacements (non-historic bridges only),
- Bridge deck replacements
- Bridge deck patching and minor rehabilitation
- Roadway rehabilitation within existing right-of-way
- Intersection improvements without right-of-way or major utilities
- Drainage projects without right-of-way or major utilities
- Roadway rehabilitation projects without right-of-way or major utilities
- Roadway resurfacing projects
- Safety upgrade projects
- Guiderail projects
- Noise barrier projects without right-of-way or major utilities
- Operational improvements without right-of-way or major utilities.

Most projects in Pipeline 3 can be designed by NJDOT in-house staff.

Pipeline 4. This is the simplest pipeline of the four. Projects entering this pipeline are assigned directly to the Operations area for implementation. Minimal plan development is required for Pipeline 4 projects and usually is performed by in-house forces. Projects in Pipeline 4 may include the following (*73*):

- Resurfacing projects
- Traffic signal projects (timing and rehabilitation)
- Traffic striping

Preliminary and Final Design

At the tail end of PN and FA, a milestone is reached from the perspective of project delivery. The PN and FA phases of the project are considered complete when environmental documents have been approved and reasonable assurance for design exception documents has been obtained. Only then do projects enter the final design phase and are officially transferred to the DPM. Although this transition introduces a new team experienced in design and other technical details, the continuity of the project is provided by the pipeline. In other words, the pipeline also includes all activities related to final design. The physical transfer of the project from one unit to another does not hinder the project's delivery because the predetermined pipeline remains the same.

Another measure of continuity is provided though the project manager. As soon as a project is initiated (while it is in the DPD), a project manager from the DPM is assigned to the project. This project manager assists with issues in the project that may become design and constructability concerns when the project advances to the preliminary design phase. Because the project manager is aware of the details of the project through its preliminary stages and has assisted with certain decisions, he or she is able to mitigate risks more effectively when the project hits "speed bumps." This project manager is the one individual who guides the project from concept to completion.

Construction

The pipeline process carries a project into construction once the project's contract documents, including plans, specifications, and estimates for construction, are completed. Again, continuity is provided through the pipeline even though a construction team takes the lead for the construction of the transportation facility. The project manager remains on the project and works closely with the resident engineer in the field until the project is constructed.

Tools

To track a program and the numerous projects that compose its surface transportation aspects, a sophisticated software is used that can monitor the minute details of every

project in the pipeline as well as provide summary overviews of an entire system of projects. NJDOT uses scheduling software called Primavera to track, monitor, schedule, and deliver its projects both in the DPD and in the Capital Program Management area. Regardless of pipeline, all projects—from their inception with purpose and need definition—actually follow a Primavera schedule all the way through to final design. But when a project moves into construction, a new schedule is created. The construction schedule is distinct from the previous schedule that depicted all the activities of purpose and need, feasibility assessment, preliminary design, and final design.

Consultants working on NJDOT projects provide monthly updates for projects. Updates are entered into a master schedule that then provides an outlook for a group of projects or all projects that are in the system. As a whole, projects can be compared and forecasts can be developed for future activities, delays, constraints, and the potential for acceleration.

Different Primavera schedules exist for the four pipelines so that unnecessary activities do not lengthen or delay a realistic deliverable schedule.

Back End of Pipelines

The end of the Pipeline 1, 2, and 3 processes is when the FHWA Agreement Closing and Suspense Analysis occur. A final audit is performed by an NJDOT auditor to ensure that the facilities built are acceptable. For Pipeline 4 projects, which are typically constructed in the field with minimal or no construction documents, the back end of the pipeline consists of a final product constructed in the field, whether it be an operational improvement or basic roadway striping.

Lessons Learned

NJDOT maintains a list of lessons learned. There is a formal process in place for NJDOT staff to gather, review, and maintain the existing database of lessons learned. The Program Management Office maintains this database and solicits lessons learned in order to populate and constantly update the database. These approaches often lead to process improvements, revised standards, and policy revisions.

Asset Management

Transportation funding has rarely kept up with transportation needs. New Jersey's annual capital budget is about $1.8 billion, but it is estimated that approximately $3.5 billion is needed for the state highway system. To prioritize the right projects and spend the federal and state funds more wisely, New Jersey is moving toward an asset management approach. This approach will take into consideration the entire transportation system and evaluate it on a system-wide basis. An asset management plan will provide "a foundation for strategic, tactical, and operational decision making relative to [NJDOT's] financial and human resources" so that NJDOT can use a more systematic approach to managing its assets. To move from a "worst-first" crisis response funding approach to a system-wide assessment and system condition–driven approach to investment will be a big step for New Jersey. (*74*)

Approach

The project prioritization and selection process is a four-step approach starting with asset management, moving to capital investment strategy, then project prioritization, and finally the capital program. Asset Management involves policies, programming, program delivery, and information and analysis. The use of performance measures and good data will help to drive and support the decision making. As such, performance measures and performance analysis will help in determining how well various alternative investment scenarios perform over time. Program trade-offs can be identified and the right mix of projects can be advanced to the pipelines for delivery.

The capital investment strategy allocates average annual funding targets for general categories of investments (structural assets, road assets, safety, congestion, multimodal investments and support facilities) over the next 10 years.

The third step, project prioritization, is where all the detail work begins once the capital investment targets are set. Existing project delivery schedules and cost estimates are evaluated. Existing conditions are assessed and projections are made in terms of where New Jersey wants to be in 10 years from an infrastructure perspective. New Jersey is currently in the process of setting these goals. For certain systems, such as pavement and bridge management, benchmarks exist and potential goals are set for the future. In other categories, such as safety and congestion, benchmarks are difficult to assess; ergo, the future goals and system-level outcomes are also difficult to define. An important part of this step is the involvement of the New Jersey's three MPOs. NJDOT and each MPO office negotiate project priorities and other constraints.

The last step is the formalization of a capital program and a 10-year capital plan. The capital program is a one-year program and part of the overall state budget process. It requires legislative approval for the state to use the funds on the outlined projects and programs. The 10-year capital plan requires MPO and FHWA approval, which include requirements for a four-year constrained capital.

Asset Management Steering Committee

Because asset management uses a performance-based programming approach, the Asset Management Steering Com-

mittee is in the process of defining benchmarks for various categories. This process is also providing NJDOT with an opportunity to define where the data collection gaps are in its system. While bridge and pavement categories have historically been well documented with consistent and detailed reports, other areas have very little information. The "softer" side of transportation such as safety, congestion, and quality of life are more challenging to measure and benchmark. The lack of available data for these categories complicates the goal of setting future system conditions. For instance, New Jersey may want to achieve a 70 percent improvement in the level of safety on a system-wide basis. Simply measuring the current level of safety is difficult. Future goals for levels of safety are even more difficult to establish without the right metrics. Similar challenges face the steering committee, but it has two broad goals:

- Develop an asset management plan
- Develop an asset management improvement strategy

NJDOT has a challenge ahead of it in implementing and establishing an asset management plan that can help decision makers pursue the right projects at the right time for the right cost. For now, it is relying on data that exists in its internal management systems to see where the gaps exist in its repository of information. Using that as a starting point, it will build upon that information and move forward. New Jersey is in the process of determining how and what kind of information will be required to set the benchmarks for some of the difficult-to-quantify areas of transportation which it wants to measure and monitor. The improvement strategy will continue to develop and mature the processes that are currently in place. At some point, NJDOT leaders recognize that a shift has to occur in the culture and mindset of the department in order for asset management to be a success. But that is not too far off in the horizon.

Overall, NJDOT has put in place a system of four project pipelines that simplify the flow of projects from conception through to completion, regardless of project size or complexity. This approach may be applicable to other state DOTs, depending on their particular circumstances and the political, physical, and social environments in which they work.

North Carolina

Realigning for the 21st Century and Beyond

When the North Carolina Department of Transportation (NCDOT) adopted its 2004 Long-Range Transportation Plan, the business model it was following clearly had to change. Increasing congestion, aging infrastructure, and financial limitations, coupled with its highway system's large size and complexity and continuing population growth, had strained the department's ability to adequately serve the citizens of North Carolina and other users of the highway system. The percentage of construction contracts advertised and awarded on schedule was fairly low. (*75*)

In light of this realization, officials at NCDOT were strongly motivated to seek ways of improving efficiencies, optimizing performance, and expediting program and project delivery. But the process had already begun some years earlier. In the 1990s, the department had developed a collaboration—a Merger Process—with state and federal regulatory and permitting agencies that had measurably reduced the delays that customarily followed the filing of permit applications for major infrastructure projects. More recently, the department pooled its collective expertise and took a hard look at its organization and operations, resulting in a careful but comprehensive restructuring to meet the new challenges faced in the 21st Century.

This restructuring, which provides greater accountability and tracks performance at multiple levels, has benefitted program and project delivery holistically, from conception to completion.

Background

Although North Carolina ranks 28th in the nation in geographical area, among the Eastern Seaboard states only Florida (22nd) and New York (27th) are larger. (*37*) However, in terms of gross mileage, NCDOT's jurisdiction is the second largest in the nation behind TxDOT's, having responsibility for 79,067 of the state's 103,500 miles of highway. (*76*) This percentage (76.4 percent) is the highest share of state-owned and maintained highway miles of any state in the United States, the national average being around 20 percent. In 2006, North Carolina's public roads consisted of 1,086 miles of interstate highway, 9,960 miles of other principal and minor arterials, 17,463 miles of major and minor collectors, and 74,991 miles of local roads, for a combined total of 103,500 miles. Despite the immense size of NCDOT's highway system, just seven percent of the state's roads, the 5,400 miles constituting North Carolina's Strategic Highway Corridors, carry 45 percent of the state's traffic. (*76*)

With an estimated population of slightly over nine million people, North Carolina is currently ranked 11th most populous in the United States. (*37, 77*) Like many other states, until the late 1980s, North Carolina's rural population outnumbered its urban population. However for several decades, the urban population of North Carolina has exceeded the rural population by a small percentage. (*78*) The gap between urban and rural population is widening, due partly to state residents migrating from countryside to city and suburb, but owing more to immigration from other states. Between July

1, 2007, and July 1, 2008, the Raleigh–Cary metropolitan area saw its population climb 4.3 percent to 1.1 million, making it the nation's fastest-growing metropolitan area during that period. (*79*) North Carolina's four largest cities all lie in the central Piedmont region of the state, between the Coastal Plain region to the east and the Appalachian Mountain region to the west.

VMT has gone up in North Carolina as it has throughout the nation. In 2006, NC roads experienced 101,515 million VMT, up 13.4 percent from 89,504 million in 2000. It is expected to double in the next 20 years. During the same period, the state's population is expected to grow by another 50 percent, surpassing that of Georgia, Michigan, and Ohio and making it the seventh most populous in the nation. (*80*)

North Carolina is experiencing a demographic shift and will have to adjust to the increasing urbanization along with an aging infrastructure. But the state has been impacted more by the economic shift that is gradually changing the global economy. This state, whose economy was traditionally based on tobacco, furniture, and textiles, has transformed itself into a knowledge-based enterprise. (*81*) Infrastructure management and maintenance has played a key role in supporting NCDOT's vision to become an operations-based agency.

Organizational Structure

Reorganization for NCDOT was more than simply moving some units around or creating new departments. Reorganization meant tearing down the old processes, methods, and structures and disposing of the old culture to create a solid, efficient organization. To do this, NCDOT had to expose its ideologies to an external, neutral third party and allow itself to be critiqued. NCDOT leadership engaged an outside consultant with proven expertise in organizational transformation and capability-building to help it analyze its organizational structure profile; identify its strengths, weaknesses, processes, and methods; and address project development and the permitting process.

A Transformation Management Team (TMT) composed of managers and analysts from across the department internally led the effort in designing and implementing NCDOT's transformation and future improvements. The TMT worked with the consultant to diagnose the NCDOT's situation, set priorities for transformation, and build its capabilities by identifying areas for long-term continuous improvement.

The following list includes four of the major organizational structural challenges the TMT and consultant found and NCDOT's response to them (*80*):

- A "silo culture" that discouraged coordination among business units—Employees tended to focus on meeting unit-specific goals, as opposed to organization-wide goals, resulting in "siloed," or isolated, knowledge. For example, information collected by Traffic Congestion may not be regularly shared with Planning, and information on a project site collected by the Division of Highways may not be adequately shared with the Rail Division. In addition, best practices may not have been adequately shared across the department.

  Response: A completely reorganized NCDOT, focusing on functions and processes.
- Insufficient accountability for project delivery across business units—Accountability for successful project delivery was often unclear, leading frequently to slow and inefficient project delivery.

  Response: A series of metrics and performance indicators, presented in a public-facing dashboard as well as an internal results-based reporting model.
- Inconsistent coordination and success across geographies in planning, designing, delivering, operating, and maintaining projects—Division managers would coordinate some processes with staff familiar with their regions, while coordinating others with whomever was available.

  Response: Organization of the entire delivery process, from beginning to end, around North Carolina's three geographical regions (Coastal Plain, Piedmont, and Appalachian Mountains).
- Slow, multilayered, sometimes bureaucratic decision-making processes across the organization—In some areas too many layers existed between senior, middle, and lower management with regard to decision making, leading to extended and inefficient decision making and contributing to a reduction in the Department's productivity. Unit heads were often limited in their independent decision-making power.

  Response: A concerted effort to change NCDOT's culture to provide managers with wide decision-making leeway.

Transformation Initiatives

Five transformation initiatives were identified: (a) align strategic direction with a new mission statement and goal, (b) streamline project design and delivery, (c) design a more productive organization, (d) increase accountability for and visibility of performance, and (f) improve talent management. All of these initiatives are synchronized to deliver programs more efficiently. The first links projects, programs, and services to goals. It addresses funding and creates strategic planning and function. The second initiative seeks to streamline the delivery of projects through proper prioritization. The third initiative attempts to break down the silos so that the transportation network operates as one system. This initiative assists the department in creating opportunities for shared insights, economies of scale, and single-point accountability. The fourth initiative

emphasizes accountability and visibility for performance so all employees work effectively toward corporate goals and suggests organization-wide metric-based management. The last initiative seeks to make choices about where and how to invest in human capital. Retaining critical talent, improving employee performance, and creating a culture that builds morale, collaborative approaches, and proactive problem-solving techniques help to change traditional mindsets. (*75*)

Creative Realignment

Similar to the concept of creative destruction, NCDOT has undergone a process of "creative realignment." In this process, TMT members methodically examined and often deconstructed the old organizational structure from within and created a new one. This step was essential in order for the department to sustain and remain effective in a financially strained and demographically burgeoning environment.

Under the guidance of the TMT, the department was restructured along new strategic functional alignments and responsible positions, as follows: (*77*)

- Organization Monitoring, Communication & Control—chief operating officer (chief deputy secretary), inspector general, communications director, and governance office director
- Transportation Strategy & Investment Analysis—deputy secretary for intergovernmental affairs and budget coordination and the chief financial officer
- Transportation Business Administration—deputy secretary for administration and business development and the human resources director
- Transportation Process Management—technical services director and chief information officer
- Transportation Program & Asset Management—deputy secretary for transit and the state highway administrator
- Transportation Program Delivery—chief engineer of operations and the commissioner of motor vehicles

This reorganization aligned NCDOT's direction for the future in terms of its vision, strategy, and employee engagement. It aligned leadership for both Board of Transportation members and senior management, including increased supervisor collaboration. Alignment occurred for environmental issues and values. In terms of stimulating programs, reorganization created accountability, coordination, and control among divisions; new capabilities; and motivation. Renewing the organization led to innovation of ideas and external orientation with stakeholders and other regulatory agencies so that NCDOT was more responsive and proactive. (*75*)

What resulted was a broader, more horizontal organization with more opportunities for greater communication and collaboration, leading to more cohesive processes. To inaugurate its reorganization, NCDOT adopted a new mission statement: "Connecting people and places in North Carolina—safely and efficiently, with accountability and environmental sensitivity." In addition, it set forth a series of goals that are tied directly to an online performance dashboard.

NCDOT's operations are led by the secretary of transportation, a member of the governor's cabinet. A 19-member Board of Transportation is the department's governing body and is responsible for assisting in the transportation decision-making process and approving fund allocation. Board members are appointed by the governor.

NCDOT has six divisions: Aviation, Bicycle & Pedestrian, Ferry, Highways, Public Transportation, and Rail. While the reorganization affects each one of these, this case study deals for the most part with the Division of Highways. Geographically, NCDOT subdivided the state into 14 highway divisions, as illustrated in Figure 17.

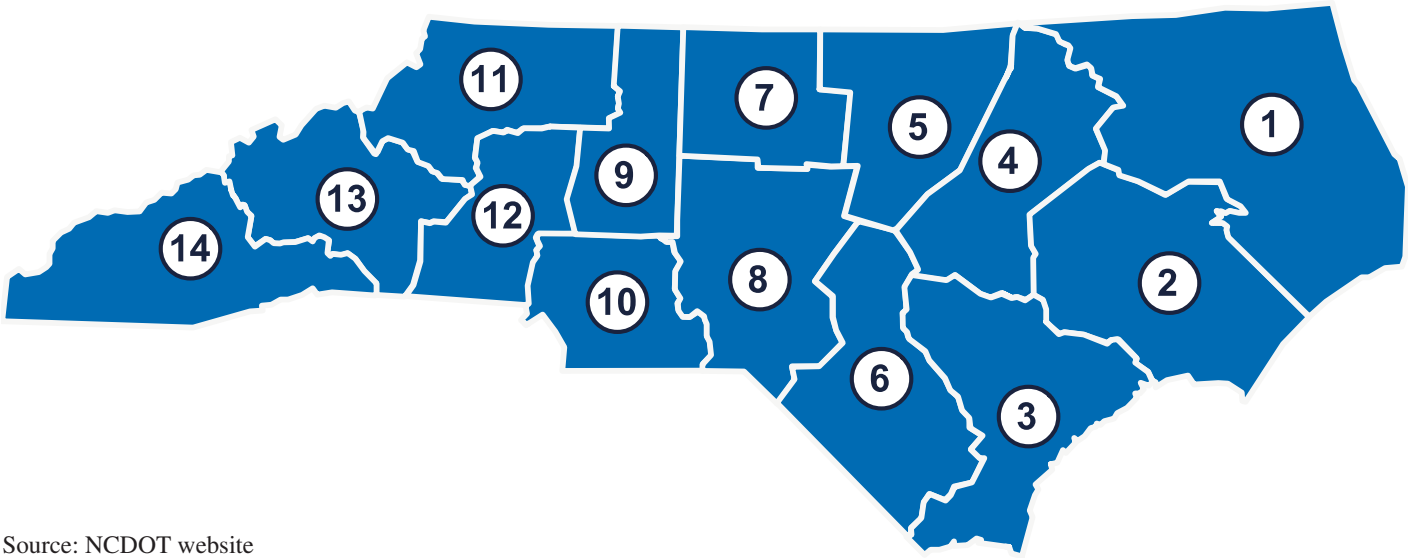
Project Prioritization

While each highway division is responsible for NCDOT's "physical plant" within its designated counties, some of the department's functions are best left centralized. One of the most important benefits of having all project development centralized, under the Preconstruction unit, is project prioritization. If this function were to be divided up by highway division, each division would advocate its own projects and vie with one another for priority. Following a single prioritization list for state transportation projects does not guarantee complete elimination of this type of competition, but it does tend to minimize the problem. NCDOT began prioritizing its infrastructure needs from a systems perspective rather than an individual corridor perspective.

Consistent Administration of Construction Management

Another area of centralization in NCDOT's organizational structure is the administration of construction activities. Within the southeastern United States, North Carolina is a comparatively large state, with a considerable number of programs and projects. However, the organization administers a standard set of policies and procedures across the state on how construction projects are managed. This standardization has facilitated a measure of control, ensuring that the same activities are carried out in the same sequence, regardless of where in the state a project occurs. Ultimately it contributes to the overall quality and integrity of the programs and projects carried out statewide by NCDOT.

A Central Construction unit provides statewide support and assists in providing consistent contract administration. While



Source: NCDOT website

Figure 17. NCDOT highway divisions.

the department's 14 highway divisions actually administer the contracts, they turn to Central Construction for assistance and guidance on statewide applications and specifications.

Considerable effort has been expended by NCDOT to develop and launch a computer program called the Highway Construction and Materials System (HiCAMS). HiCAMS is a custom application that tracks and supports highway construction work and the testing of materials used in the construction process. More than just a database, HiCAMS is a computer system into which payments to contractors, documentation of materials received (as measured by the resident engineers), and invoices are all entered. As NCDOT pays the contractors' estimates based on data entered into HiCAMS, the system can track and document invoices and payments while simultaneously tracking the status, progress, and completion of projects. The system has the capacity to indicate "approval" of a contractor's invoice—or not—based on current data pertaining to a particular job. HiCAMS also tracks contractors' claims, subconsultant agreements, and numerous other pieces of information vital to administering programs and projects in an efficient, accountable manner.

Originally developed in the late 1990s, HiCAMS has been undergoing constant improvements and enhancements ever since. With HiCAMS in place, contractor invoices get paid within 30 to 60 days from receipt of invoice, and in some cases in less than a week. When these wait times are compared with waits of up to 120 days or more that contractors experience with other DOTs and agencies, it becomes evident that keeping information current is actually more efficient than requiring people at various levels of management to approve an invoice in order for it to be processed and paid.

Current Funding Sources

For the 2007–2008 fiscal year, NCDOT's $3.9 billion budget was funded 47 percent by a state highway fund ($1,832 million), 29 percent by a highway trust fund ($1,128 million), 24 percent by federal funds ($943 million), and 0.6 percent by department receipts ($24 million). State transportation revenue sources are supplied as follows: motor fuel tax, 55 percent; highway use tax, 25 percent; and fees, 20 percent.

That same $3.9 billion was projected to be divided up such that highway maintenance and Transportation Improvement Plan (TIP) construction received the largest funding at $898 million and $1,556 million, respectively. Other construction, non-highway programs, other agencies, and municipal aid receive the remainder of funds. (*82*)

Best Practices for NCDOT

Merger 01: Streamlining Project Development and Delivery through Concurrence

Over the course of the past 12 years, NCDOT has actively sought ways to streamline the project development and permitting process that so often halts progress on a project schedule. Merger 01 is the process that was developed to provide a common forum for discussion so that, through interagency coordination, comprehensive evaluation and resolution of issues could occur. This process results in quicker and shared decision making. (*83*) Merger 01 is a multiagency initiative whereby regulatory agencies—including various branches of the state Department of Environment and Natural Resources

(DENR), the U.S. Army Corps of Engineers (USACE), the FHWA, other state and federal agencies, and numerous areas of the NCDOT—meet together and formally register their concurrence at strategic points in the development of projects from their earliest conceptual and planning phases.

Very often in the past, after reviewing a submitted design, permitting agencies (such as DENR and USACE) were likely to return it with recommended modifications to avoid, minimize, or mitigate impacts to surrounding areas that would result from a proposed action. Because for many projects, more than one permit needs to be obtained—often from more than one regulatory agency—before design and construction can begin, this process could be very time consuming. Also, modifications made on a project during the final design phase invariably cost more and may be more time consuming than if the same changes were requested at an earlier stage of the project.

To address these issues, and in an attempt to remedy an unacceptably low ratio of projects let to projects in design in a given fiscal year, NCDOT initiated talks with DENR and USACE regarding new alignment projects and projects requiring an individual permit under Section 404 of the Clean Water Act. FHWA, USACE, DENR, and NCDOT entered into an agreement to consult early in the project development process and identify specific projects that would follow the Merger 01 process, through the application of screening criteria.

As part of an effort to streamline the project development and permitting processes, an agreement containing a set of procedures integrating NEPA and Section 404 for transportation projects in North Carolina was signed in May of 1997 by the Wilmington District of USACE, the North Carolina division of FHWA, DENR, and NCDOT. This agreement was supported by a federal action that took place in May of 1992 when the U.S.DOT, the Office of the Assistant of the Army (Civil Works), and the U.S. Environmental Protection Agency developed a policy that would (a) improve interagency coordination and (b) integrate NEPA with Section 404 procedures.

The agreement was modified early in 2005 based on experience using the 1997 agreement and guidance provided by a process improvement workshop held by a team representing the three key agencies. Additional streamlining provisions of TEA-21 were incorporated as well. Evaluation of this process for its effectiveness is ongoing, and the team is making modifications, as appropriate.

The Merger 01 process accelerates projects. The team, consisting of representatives from the NCDOT and regulatory agencies, meets on a project at strategic points in the project development process and makes balanced decisions that move the project forward so that potential project development and environmental-related risks are avoided. All players provide input on project decisions, with the intent that the environmental review and permitting processes will go quickly, and post-review modifications to the design can be minimized.

Concurrence is Key. The key to Merger 01 ratcheting the project forward is the concept of concurrence. Each team member—and by association, the agency he or she represents—agrees to decisions made throughout the development of the project. This agreement constitutes a pledge by the agency to abide by the decision made and not to revisit previous concurrence points unless substantive new information surfaces that warrants a re-evaluation.

A multiagency, multilevel team was formed to determine what was needed to make a decision at each concurrence point. The milestone concurrence points in a typical project under Merger 01 are as follows:

1. Purpose and need and study area defined
2. Detailed study alternatives carried forward

2A. Bridging decisions and alignment review (if applicable)

3. Selection of the least environmentally damaging practicable alternative (LEPDA)/preferred alternative (The LEPDA is the NEPA-preferred alternative.)

4A. Avoidance and minimization—A detailed interdisciplinary and interagency review to optimize the design and benefits of the project while reducing environmental impacts to both the human and natural environment

4B. 30 percent hydraulic review

4C. Permit drawings review

Merger 01 provides for resolution of issues causing nonconcurrence, in the event that an agency cannot concur. It prescribes the procedure to be followed for three basic types of projects:

- Projects on new locations
- Widening and other improvement projects
- Bridge replacement projects processed as a Categorical Exclusion

Following the Merger 01 methodology has been found to save at least six months on a given project's overall schedule. By far, Merger 01 has accelerated the program and project delivery process for NCDOT. As a result of these formal concurrence points, project review in subsequent stages is minimized, approvals are speedy, and re-submissions are practically nonexistent.

Collaboration Accelerates Projects. The entire process of formulating the Merger was successful on several levels. It involved a greater number of people in each of the agencies, and enhanced communications and relationships within and between all of them. Senior leaders recognized the need to work together on common goals and participated in the meetings. Top people from the agencies (the secretary of transportation, the colonel from the USACE Wilmington District, and the

Secretary of DENR) spoke on what their expectancies were from the workshops. When mid-level managers and line employees saw and heard these individuals at the workshops, they realized what an important issue this was.

As an added benefit, upper-level managers from the various agencies got to know each other better and now feel comfortable placing a telephone call to one another and speaking directly to top people in other agencies when issues arise. "Shared decision-making in the Merger process really moves things forward. It's not just someone's input; its concurrence and an agreement not to . . . revisit unless there's huge new information." (*84*) Merger 01 documents all decisions made on projects as they advance from planning through permitting and design, so that if a new project manager inherits a project, a history of how the project developed and was shaped into its current state is available. All the participants, key decision makers, and decisions are noted so that time is not lost in going back to justify the major decisions that so influence the flow and flux of a project.

As one NCDOT executive noted, "In an emergency situation, you develop one overarching goal, and it gets accomplished. There is a lot of ownership and everybody breaks down the silos and does whatever it takes. There is a common priority—project delivery is the goal." But in a non-emergency situation, what happens to the jobs and the deliverables? "Working in merger-type relationships, you're working with a sense of trust. The trust is built through relationships." It is a matter of collaborating with a sense of trust versus laboring under a sense of urgency. (*84*)

Organizational Performance Dashboard

One of the initiatives identified by the TMT was to address the issue of performance and accountability. An outgrowth of the Merger 01 process was the imminent development of performance metrics and management. Using the five goals of the organization and keeping in line with the long-range plan, NCDOT created a department-wide dashboard that is available to the public via its website. The dashboard serves as a real-time indicator of how well the organization is accomplishing its mission and meeting its goals.

The process to create and implement a system that was usable and reflected the department's goals and missions was difficult and required much support and guidance from upper-level management. It involved six tedious steps: (a) development of performance measures, (b) establishment of benchmarks, (c) strategic program development, (d) communication and implementation, (e) reporting and feedback, and (f) analysis and retool.

These steps were designed to operate iteratively, in a continuous cycle, so that after "retooling" (step f), the TMT would revisit the performance measures (step a), and move through the cycle again and again, making refinements as needed to each component of the reorganization along the way.

The first step linked the mission statement with the goals, which then tie into the metrics. The value tree shown in Figure 18 shows the critical steps that NCDOT took toward establishing measures.

NCDOT addressed many challenges, including long-term viability; buy-in from all levels; incremental gains versus "miracles"; establishing realistic, attainable goals that are easily measured; and creating challenging and rewarding work. "Putting the pieces together" in the overall context of NCDOT's business plan and the 25-year Statewide Transportation Plan was a great accomplishment, as shown in Figure 19. (*77*)

NCDOT's organizational performance dashboard is an online tool that uses a set of gauges to indicate performance based on actual, real-time statistics. So far, NCDOT has designed metrics for more than 40 independent units. The metrics are linked to the performance dashboard and continue to be reinforced with new performance management programs. The dashboard, which can be accessed by anyone through the NCDOT website, is shown in Figure 20.

The dashboard web page is the "tip of the iceberg." By clicking on any of the gauges, the Internet user can bring up more detailed information on the metrics that combine to determine the reading on that gauge. While the gauges on the dashboard show performance statewide, a user interested in a specific location's performance can drill down to view the same data for any of North Carolina's 100 counties.

The performance-based management model is intended to provide a longer-lasting transportation network, operating at lower costs with fewer traffic interruptions. Already, $40 million in savings have been identified through interagency collaboration to find ways of saving on the cost of designing and delivering transportation projects. (*85*)

NCDOT's overall performance results for the fiscal year 2008 are impressive: the share of measured activities that met or exceeded expectations was 75.8 percent. (*77*)

Future Developments

Interagency Leadership Team

In 2004, NCDOT advocated for the formation of an Interagency Leadership Team (ILT), understanding that the transportation system needs to be planned in coordination with economic development, and protection and enhancement of cultural and natural resources, which are also extremely important to the citizens' quality of life. A large group of state and federal agencies was brought together in May of 2004 and began meeting on a quarterly basis with the goal of improving existing operations. More recently, the ILT identified a strategic plan and refined its original three goals: (*86*)

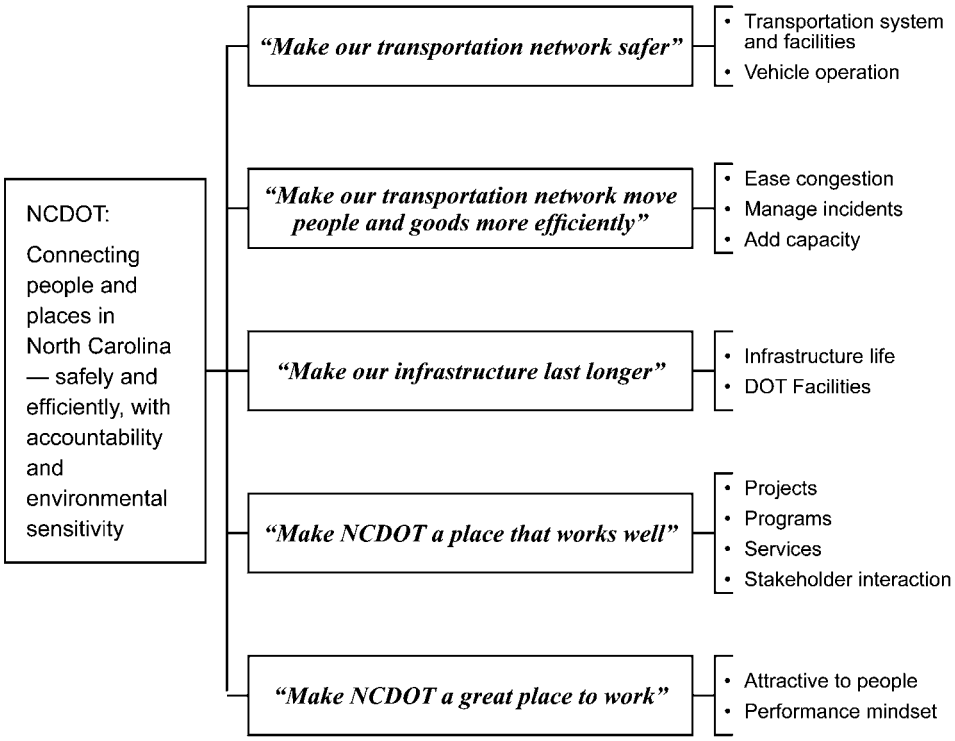
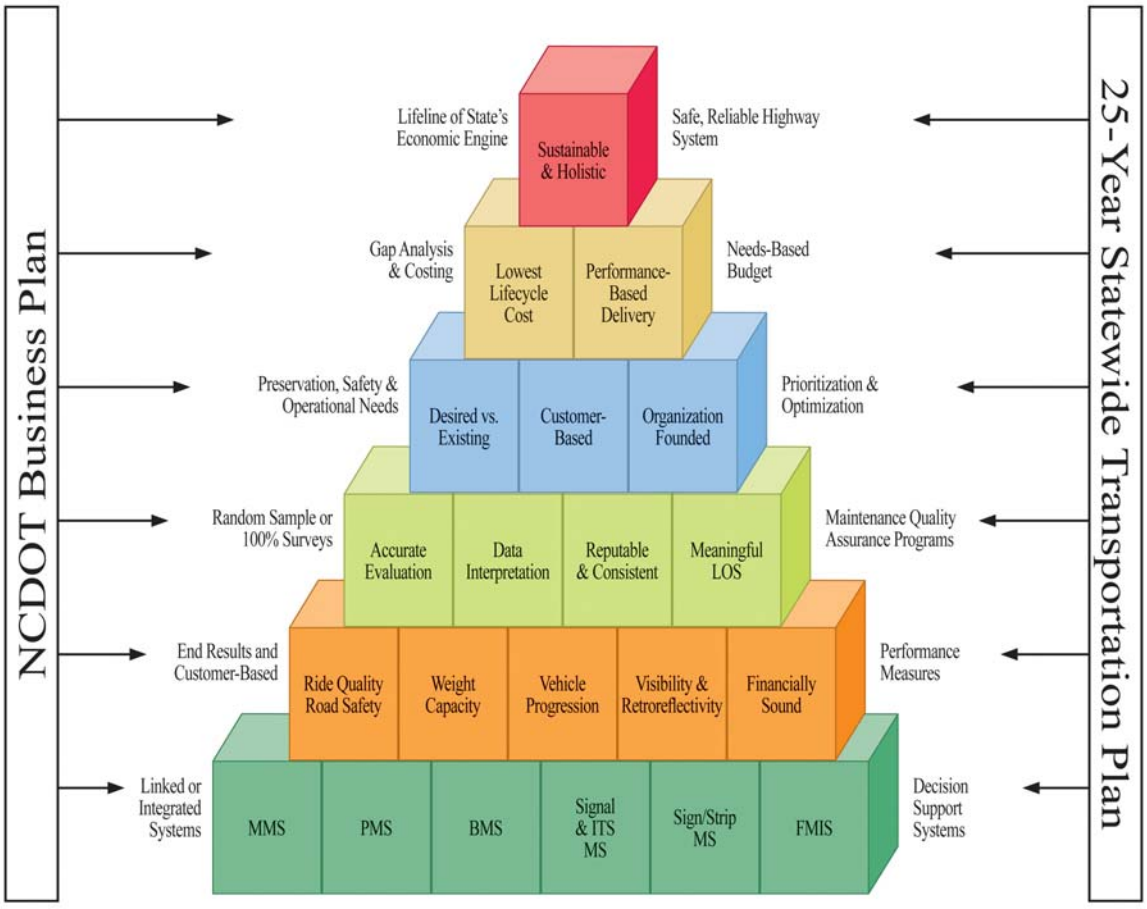
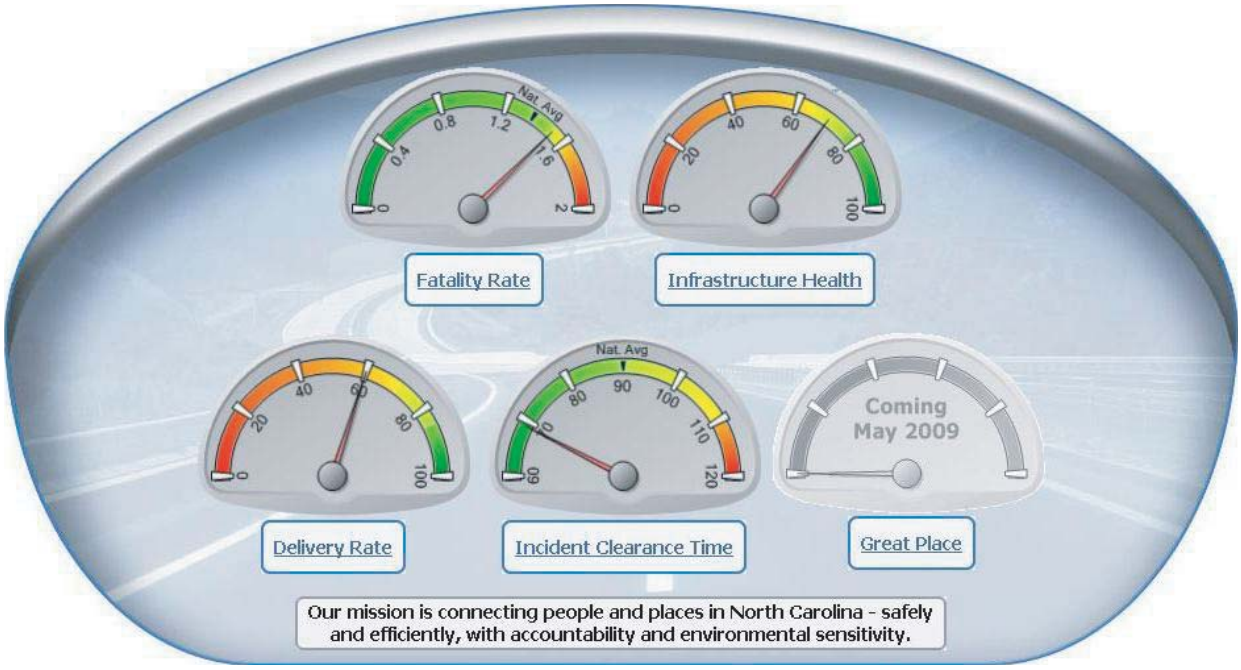


Figure 18. Value tree linking mission statement, goals, and metrics.



Source: NCDOT website

Figure 19. Putting the pieces together.



Source: NCDOT website

Figure 20. NCDOT's organization performance dashboard.

- Develop a shared, comprehensive Geographic Information System (GIS) database.
- Partner with local governments and other stakeholders to integrate local land use and long-range transportation planning, as well as applicable environmental and economic planning initiatives, to meet mobility, economic, and environmental goals.
- Improve the Merger 01 process.

This last goal of the ILT is a commitment to improve a current program that has helped to transform NCDOT. Merger 01 is an exemplary program and is recognized nationally as an innovative approach to state and federal cooperation in transportation improvement and environmental protection. However, it has not achieved perfection; it can go further still. Even though work groups and appropriate technology exist to train team members, Merger 01 has not received formal approval by all state and federal partners. NCDOT is continuously striving to maximize the full potential of the Merger 01 Process. (*86*)

Continuous Process Improvement

Continuous process improvement (CPI) is a program designed to increase productivity, cut costs, enhance customer service, and improve business processes. NCDOT employees are encouraged to innovate, document, and submit process improvement techniques under the criteria of improved communications, customer service, cycle time reduction, dollar savings, energy and environment, labor-hour savings, and safety. Annual winners are rewarded through recognition of their ideas. CPI has proven to stimulate, promote, and sustain a culture of innovation and improvement throughout all levels of the department. (*87*)

CPI is not a performance measure *per se,* but rather a recognition program that encourages innovative thinking and goes beyond rewarding improved processes to publicizing them and encouraging their application statewide. At a CPI Conference held annually, NCDOT employees gather from throughout the state both to receive awards for their process improvements and to learn newly developed best practices from one another. Awards are presented for each of the seven process categories, and NCDOT compiles a CPI Results Book annually (available on NCDOT's website) to make the three winning improvements in each category available to the entire department.

More than a recognition and celebration forum, CPI is a search for improved methods and outstanding successes, not from high-ranking officials and management consultants but from the people who perform the work and face the challenges on a day-to-day basis. It institutionalizes a culture of continuous improvement.

Strategic Planning Office

NCDOT plans to launch a Strategic Planning Office to continuously align its direction with stated priorities and to make

the current transformation of the organization sustainable. The Strategic Planning Office will ensure that NCDOT is continuously responsive to the needs of North Carolina's citizens. (*88*)

Improvement of Performance Measures

NCDOT is in a mode of constant improvement and renewal of processes and programs. In establishing performance measures, NCDOT has become more transparent to the public and political entities, but still recognizes that the journey to improving its organizational structure is not over. It aims to continue developing metrics toward accountable outcomes. These metrics in turn will lead to more projects being delivered on time and on budget, using taxpayer money most efficiently. (*80*)

Another bold step in measuring performance is also taking form: implementing a new individual performance management system that evaluates employees' job performance against an objective set of performance measurements and agency values that will help employees to plan their careers and achieve their development goals.

Conclusions

NCDOT has made some targeted changes in the last few years. Bold steps toward a complete reorganization and the implementation of performance measures leading to greater accountability, transparency, and efficiency have shaped NCDOT into an agency intent on expediting the delivery of programs and projects. Outcome-based systems, operationally effective processes, a horizontally stable organizational structure, and a concerted system-wide effort toward continuous improvement are the traits that will define the 21st century department of transportation. These trends will continue to serve as the foundation for a new NCDOT.

Texas

Evergreen Contracts for Efficiency in Project Delivery

The Texas Department of Transportation (TxDOT) describes its mission as, "to work cooperatively to provide safe, effective and efficient movement of people and goods." That mission is supported by the department's vision, which includes the goal of being a progressive state transportation agency recognized and respected by the citizens of Texas. (*89*)

Texas is a large south-central state with the second largest population in the United States. With over 24 million residents and a land area just shy of 262,000 square miles, the average population density of the state mirrors that of the United States as a whole, 79.6 persons per square mile. However, Texas features a population growth rate roughly double the average of the greater country. (*90*) An increasing population leads to greater strains on the transportation network, especially in the metropolitan areas such as Dallas and Houston. The Texas Transportation Mobility Institute ranked Dallas–Fort Worth and Houston as the fourth and ninth most congested areas in the nation, respectively. (*91*) To meet the mobility needs of such metropolitan areas, the governor's Business Council estimates that an additional $78 billion is required over the next 25 years to invest in highway improvements. (*29*)

The state ranks number one in the country in terms of total highway mileage. In 2000, Texas had over 301,000 miles of public roadway. Of that, TxDOT is responsible for over 79,000 highway miles. That figure is more than any other DOT in the country. (*92, 93*) The agency maintains 1,132,881 acres of right-of-way; nearly 1.5 times the acreage of Rhode Island. (*94*)

The state features a diverse landscape that expands from the Piney Woodlands of the east, through the prairies of north and central Texas, to the arid southwestern desert of west Texas. These landscapes vary from vast open expanses, to rolling hills, to rough and rugged mountainous regions. The climate of Texas also varies considerably, from the extreme humidity of the east to the dry deserts of the west. Hurricanes and tornados have presented recurring challenges to Texas's population and its transportation system. In 2005 alone, Hurricanes Wilma, Katrina, and Rita caused the evacuation of 1.8 million vehicles from the Texas Gulf Coast, imposing an overwhelming burden on the transportation system. (*95*)

The Basics

The stated goals of TxDOT are to reduce congestion, enhance safety, expand economic opportunity, improve air quality, and preserve the value of transportation assets. In furtherance of these goals, TxDOT has implemented four working strategies: to use all financial options to build transportation projects; to empower local leaders to solve local transportation problems; to increase competition to drive down costs; and to demand consumer-driven decisions. (*96*)

For transportation funding sources, TxDOT, like most states, relies heavily on federal disbursements, which constitute 38.9 percent of total funding. The state highway fund is the second greatest contributor to transportation funding in the state, representing 31 percent of the total. The state highway fund is fed primarily by the state motor fuel tax, with additional revenue generated by vehicle registration fees and other sources. (*93*)

Just behind the state highway fund, bond issuance constitutes roughly 30 percent of funding sources. This is a relatively recent development, as TxDOT maintained a fiscally conservative, pay-as-you-go disposition for the first 90 years of its

existence. In 2007, voters approved Proposition 12, which for the first time allowed the agency to incur debt to deliver critical transportation projects. (*93, 97*)

This ability to issue bonds has resulted in a significant shift in the organization's philosophy. For most of its history, TxDOT would not pursue projects without secured funds. The project selection process now begins with identification of need, which is followed by funding considerations. The department maintains a backlog of projects that are ready to let, save for funding. As funding sources become available, that backlog of projects is tapped. (*97*)

As a means of organizing agency operations and creating a framework for setting and tracking goals, TxDOT consolidated operations into five major categories: Plan It, Build It, Maintain It, Use It, and Manage It. These categories encompass all of the department's operations and are listed here in order of agency funding allocations. (*94*)

The largest share of TxDOT spending is conducted within the Build It category. Approximately 40.4 percent of the department's spending goes to construction projects. These projects can be generally described as capacity enhancements and include both new projects and those that improve or expand existing infrastructure. (*94*)

An additional 35.5 percent of revenue is spent on maintenance of the transportation system, or the Maintain It operational category. The department's maintenance strategy emphasizes the safety of existing infrastructure. It involves reconstruction and rehabilitation of the state highway system, including structures and signal systems, as well as the Gulf Intracoastal Waterway and the ferry systems at the ports of Galveston and Port Aransas. (*94*)

The third large operational expenditure for TxDOT is the Plan It category. Planning accounts for 19.1 percent of the department's budget. Planning activities are performed for all modes and include environmental design activities. Is also includes acquisition of right-of-way and payment of relocation expenses when necessary for transportation projects. The planning budget also includes research programs that aim to improve safety and financial or operational practices. (*94*)

The remaining five percent of the budget is split between what TxDOT describes as Manage It and Use It. Manage It includes administration and human resources, while Use It covers issuance of vehicle titles and registration, regulation of motor vehicle dealers, providing information to the traveling public, and provision of public transportation outside of metropolitan areas. (*94*)

Organizational Structure

The overall organizational structure of TxDOT has been designed to suit the state's unique geography and mission. This structure is decentralized and designed to accommodate the state's vast size. It reflects willful recognition on the part of the department's leaders that a centralized structure would have difficulty managing far-flung infrastructure and systems, which are faced with widely different challenges and demands. That is why one of the department's operational strategies is to empower local leaders to solve local transportation problems.

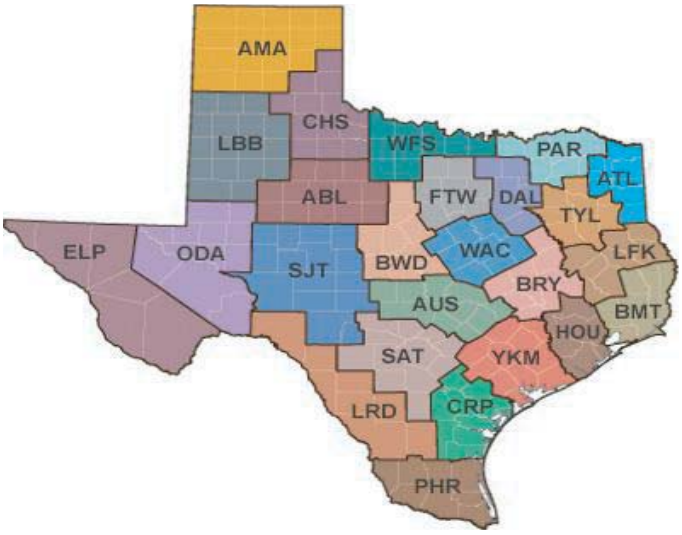
At the central level, the department headquarters is based in Austin. The Texas Transportation Commission, a board appointed by the governor, sets department-level policies. An executive director leads the department and reports to the commission. (*94*) The executive director is assisted by four assistant executive directors who oversee several operational activities, namely, district operations, engineering operations, support operations, and innovative project development. (*98*)

The department houses 18 divisions (as of November 1, 2009) and six offices. The six offices include the Audit Office, Automobile Burglary and Theft Prevention, Office of Civil Rights, Office of General Counsel, International Relations Office, and Research and Technology Implementation. The 18 divisions consist of Aviation, Bridge, Construction, Design, Environmental Affairs, Finance, General Services, Government and Public Affairs, Human Resources, Maintenance, Occupational Safety, Public Transportation, Right-of-Way, Technology Services, Texas Turnpike Authority, Traffic Operations, Transportation Planning and Programming, and Travel. These divisions provide technical expertise and support for categories ranging from bridges to government and public affairs to traffic operations. The offices and divisions provide administrative and technical support to the districts. (*98*) In addition to technical expertise on engineering and planning issues, these offices ensure statewide consistency in policy and approaches.

Texas has been divided into 25 districts, each loosely encompassing a metropolitan region, typically spanning several counties (see Figure 21). The districts oversee the design, location, construction and maintenance of the area's transportation systems. Each is led by a district engineer. (*98*) Under the department's allocation program, each district is given a set budget to select and fund certain types of projects. This program is intended to give the districts the flexibility necessary to address local needs. (*94*)

In many regards, the decentralization of decision-making authority has proven to be a success. There is general agreement internally at TxDOT that the districts are well suited to identify and respond to the unique demands of each of their respective areas. With the allocation of limited funds, the districts are motivated to prioritize projects critically and explore creative solutions.

Decentralization has proven particularly effective with projects where public involvement or environmental concerns are at play. Senior TxDOT staff feels that when a project is delivered from beginning to end at the district level, there is greater



Source: TxDOT

Figure 21. TxDOT's 25 Districts.

buy-in and support from the public and accountability for environmental commitments increases. (*97*)

However, the department is currently undergoing a period of reorganization. Under this strategic restructuring, TxDOT has sought to move some functions to a new regional organizational tier. This effort is aimed at improving efficiency and eliminating redundancies, without undermining the success of decentralized decision making. This strategy has sought to consolidate some of the responsibilities from both the district and the central levels. (*97*)

Under the reorganization, Texas has been divided into four regions, each containing five to seven districts. Regional tier roles and responsibilities are being established and are not yet finalized. The goal is to take some of the redundant functions from the districts and some of the authority of the central office that could be better administered at the regional level. For instance, it is thought that some functions such as sign shops, which are currently conducted at the district level, could be elevated to the regional level, creating efficiency. A single sign shop could likely produce signs for five or six districts without a significant loss in quality or responsiveness. (*97*)

Likewise, environmental or design responsibilities, which are currently conducted at the central level, could be administered at the regional level for some projects in order to enhance responsiveness and accountability. It is believed that the required environmental review or design approval for many projects is actually rather straightforward and could be addressed at the regional level. This, again, would create greater efficiency. Other projects, which span regions or involve a higher degree of risk, would continue to be reviewed and handled at the central level. (*97*)

Environmental Streamlining

During the drafting of the latest transportation funding legislation, SAFETEA-LU, Texas successfully lobbied, along with four other states (Alaska, California, Ohio, and Oklahoma), to be a part of a pilot program that granted FHWA NEPA review authority to these individual states' DOTs. The program is intended to provide time and cost savings through more efficient environmental review. (*95*)

Best Practices for Texas

TxDOT has demonstrated a willingness to explore innovative practices in terms of financing projects and project delivery. This experimental spirit is born of the department's desire to meet ever-changing demands in an economically limited environment. The department includes "using efficient and cost-effective work methods that encourage innovation and creativity" in its vision. That creativity and innovation have manifested themselves in a wide array of financing, contracting, and project delivery tools. (*89*)

Like many states nationwide, Texas has seen large population growth over the past 20 years and a disproportionate increase in VMT, due largely to land use growth patterns. This growth is occurring without a matching expansion in funding for transportation projects, resulting in a system that is increasingly strained. In fact, "from 1980 to 2006, Texas' population has increased by 65 percent, and its road use has increased by 120 percent. The state's roadway capacity, however, has only grown by nine percent." (*99*)

Pass-through Financing

To address this disparity, the department has employed a variety of innovative financing tools. For example, TxDOT has pioneered a method referred to as pass-through financing. In this model, any public entity, such as a regional mobility authority or local government, or even a private developer, can submit an application. An approved application entitles the developing entity to finance, design, construct, maintain, and/or operate a state highway project. The program is open to expansion projects as well as new projects. In return for covering the up-front costs, the state repays some portion of that debt over time, based on a per-vehicle rate. If there is high demand for the project, the state will repay the developer more quickly, while a lesser-used project will be paid more slowly. This arrangement provides incentive to pursue high-demand projects and enables their construction when the up-front costs may not be available to the department under conventional funding mechanisms. The department considers this both an innovative financing tool and a tool for project acceleration. The project is accelerated because

without the developer entity supplying the up-front costs, the project would be delayed. (*100*)

This program is young, having been approved in early 2009, and its success remains to be measured. However, the program exemplifies the pioneering spirit of TxDOT and its willingness to experiment. This experimentation carries to all stages of project delivery.

Comprehensive Development Agreements

To enable public–private partnerships (PPPs) and other innovative methods, the agency has initiated comprehensive development agreements (CDAs). CDAs are contracts between TxDOT and a consortium of contractors. The agreement entitles the consortium to perform all or portions of a given project's design, construction, operation, and maintenance. These agreements accelerate project delivery by allowing for parallel processes. In the traditional model, each phase of project delivery must be completed before the next phase can go out to bid. Under a CDA, these phases can overlap, as appropriate. (*94*)

The agreements have allowed for experimentation with a variety of project delivery methods. For example, for a 51-mile segment of State Highway 130, part of the Central Texas Turnpike, the department initiated a design–build–maintain agreement that included a provision for partial financing by the contractor. For another 40-mile segment, TxDOT opted for a full concession. TxDOT estimated that with traditional funding and contracting methods, the project would take 20 years. With the CDA in place, the project will take half of that time. (*94*)

Evergreen Contracts

Yet another innovative contracting method that TxDOT has employed has been evergreen contracts. These contracts have given the agency a flexible tool that has both aided in project acceleration and provided greater control over funding streams in times of economic hardship or prosperity.

The evergreen, or indefinite deliverable, contract is a form of on-call services contract designed to pre-screen contractors for a specific type of work. The contracts are then exercised on an as-needed basis. They are drafted for a set maximum dollar amount and a set period of time, rather than for a fixed deliverable. When either the preset dollar threshold or the lifetime of the contract has reached its limit, a new evergreen contract must be advertised for bids.

Evergreen contracts were initially developed to address the need for a flexible tool for designing unforeseen or otherwise out-of-scope pieces of existing contracts. They were never intended to be a solicitation method for large projects. As such, a cap is placed on the maximum total value of the contract and/or the total duration. As of today, those caps stand at $2 million and two years, although in certain circumstances, these maximums can be extended, and the department is considering increasing the caps. (*101*)

The selection process for evergreen contracts is rigorous. The department is careful to select contractors who are adaptable and will perform high-quality work. It is essential that the contractor be able to perform work on a variety of different projects and in different settings. From the department's perspective, this selection process can be very time consuming. (*97, 101*)

However, for the districts, these contracts have proven to be a very useful tool for certain types of projects. Specifically, evergreen contracts can be very efficient for projects that involve less risk, are less complex in nature, or involve a specific type of task that is common to many active projects within a district. (*97*)

Another significant benefit of using evergreen contracts is that the TxDOT districts have the ability to adjust their implementation or use depending on the availability of funding. When funding is scant, the district simply does not issue work orders on the evergreen contract. The agreements generally have a clause that permits the department to allow an evergreen contract to sit inactive for six months or a year without any repercussions. This can help the districts weather a down cycle without compounding budget constraints. (*97*)

The TxDOT districts have also made creative use of evergreen contracts by drafting multiple contracts with multiple contractors with overlapping terms so that as one is expiring, another is already initiated so that the district always has a contractor on hand to perform a given activity. (*97*)

Evergreen contracts have proven to be an effective tool for accelerating project delivery for small projects and in instances where unforeseen or out-of-scope components arise on large projects. The TxDOT environment, where the decentralized districts are granted a great deal of decision-making ability, makes this tool particularly efficient. The district decision makers are generally most knowledgeable about local projects and therefore can be most responsive by initiating an evergreen contract work order quickly and to the most qualified contractor for the job.

Because the selection process is time consuming, some senior TxDOT staff feel that the evergreen contracts should incorporate longer time spans and larger dollar caps. These increases would enable more flexibility for the types of project for which they are deployed and reduce the relative amount of time that the department spends on selection versus the life of the contract. (*97*)

The contractor community has been resistant to increasing the nominal value or duration of evergreen contracts because it is felt that they hamper competition. The sense is that every contractor would like to be able to bid on every contract. (*97*) There is also concern on the part of centralized sen-

ior TxDOT staff that evergreen contracts encourage the use of the contractor on hand as a matter of convenience, as opposed to selecting the best contractor for a given job. It is feared that expediency or practicality could endanger project quality. (*101*)

Overall, a balance should be found between accelerating project delivery and hampering competition. There is also consensus that it is important to limit the use of evergreen contracts to smaller projects, as they don't perform as well on large and complex projects, which often require highly specialized skill sets rather than the versatility required of firms selected for evergreen contracts.

Conclusions

Evergreen contracts are not a panacea for project acceleration. Rather, these contracts are one tool that a state DOT can keep in its acceleration toolbox. TxDOT has found that when unforeseen design issues arise on larger projects, this form of contracting can provide an accelerated solution.

TxDOT uses these contracts in conjunction with a wide variety of financing and contracting methods. The use of multiple tools and the organization's regional restructuring are emblematic of TxDOT's willingness to experiment. In these uncertain economic times, the department's past ability to adapt and find creative solutions to external forces portends well for its future.

Utah

Construction Manager–General Contractor

Utah Department of Transportation (UDOT) considers its charge to include a holistic approach to transportation in the state. The department describes its mission as, "quality transportation today, better transportation tomorrow," and recognizes a fundamental connection between the state's transportation system and the overall quality of life and economic prosperity. (*102*)

Utah is a large western state (13th in the nation ranked by area), with a projected population under three million. While Utah features a very low overall population density, that population is significantly city based, with 88 percent of its population located in urban areas. The state's population is clustered largely around Salt Lake City along the Wasatch Front, with some growth occurring in the St. George area. (*103*)

The state has experienced tremendous population growth over the past several decades. Between 1990 and 2007, Utah's population grew roughly 47 percent, with much of that growth concentrated in the urban areas. (*102*) During that time, Utah has consistently been one of the fastest growing states. For several years, including July 2007 to July 2008, Utah topped the list of the highest growth in the country, with a population growth rate of 2.5 percent. (*104*)

Utah's state highway system is composed of close to 41,000 centerline miles of highway roads. Of that, UDOT is responsible for approximately 6,000 miles. (*105*) While state responsibility accounts for roughly 14 percent of the total roadway miles, these roads carried roughly 67 percent of the total VMT in 2007. (*106*)

Transportation infrastructure has not kept pace with the booming population. From 1990–2007, Utah experienced a growth in VMT of 71 percent, but added only four percent capacity to its highway system. In reaction to this pressure, UDOT has adopted a strategy with four goals: maintaining the existing system, improving system efficiency, improving safety, and building capacity. The department feels that building capacity is necessary to meet the needs of the population but notes that, because of financial constraints, highways cannot be built fast enough to keep pace with growing congestion problems. (*102*)

Utah is unique in terms of funding transportation projects in that the DOT relies heavily on state funding. While UDOT does take advantage of federal aid funding for qualifying projects, the department generally receives a significant portion of its capacity expansion project funding through the state legislature. That money is allocated from the state General Fund and fed into the Transportation Investment Fund, Critical Highway Needs Fund, or the Centennial Highway Fund.

The Transportation Investment Fund is designated for maintenance, construction, and reconstruction. The majority of the revenue for this fund is generated by the state sales tax, but it is also fed by legislative appropriations. Money remaining from the latter two funds is also deposited here when their projects are completed with a surplus. The Centennial Highway Fund is an allocation of state and federal money for use on 43 capacity-driven projects. Each of these projects is included in the Statewide Transportation Improvement Plan (STIP).

The Critical Needs Fund revenue comes from voluntary contributions, legislative appropriations, and sales and use tax. This fund is used for transportation projects around the state, as determined by UDOT, the state Transportation Committee, and the Executive Appropriations Committee. This fund is generally used for capacity expansion projects that are deemed high priority due to population growth. These projects generally do not receive federal aid.

Organizational Structure

UDOT's overall strategy has been to centralize some technical knowledge–intensive functions while decentralizing functions that require local knowledge. This strategy has been implemented under a matrix management model.

UDOT has divided the state into four regions (Figure 22); Region 4 has been subdivided into three districts. Each region is assigned a region director.

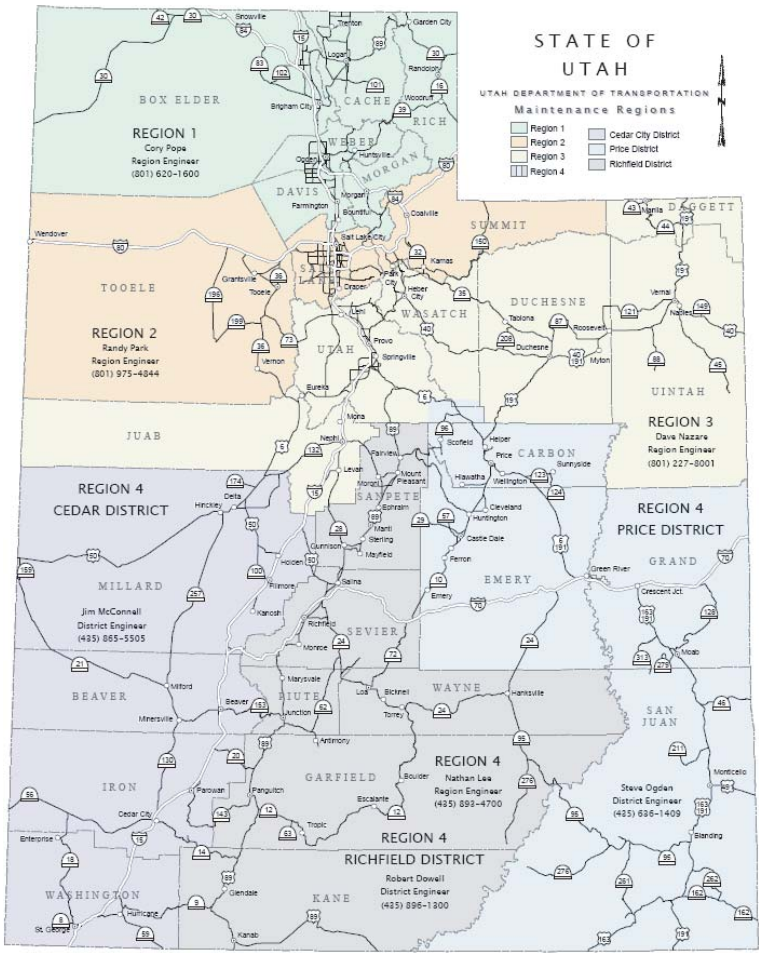
The region director is at the top of the matrix model and oversees five position categories:

- Administration
- Project managers
- Pre-construction engineers
- District engineers
- Materials engineers

Project managers are regional staff members who are responsible for overseeing the scope, schedule, budget, and quality of a given project. They provide continuity of project knowledge throughout all phases of a project. Project managers oversee project-specific teams for each project and will generally manage between 10 and 15 projects at a time, though not all are advertised in the same year. The project manager also administers contracts for consultant projects. (*107*)

Project teams, as managed by the project manager, are composed of staff from any and all of the applicable position categories listed previously. These teams are assigned on a project-by-project basis and are not static across all projects under a specific manager.

Program managers are centralized and assist project managers with managing the region's transportation program from initial planning through design, construction, and project closeout (see Figure 23). Their responsibilities include securing funding for projects and determining project funding priorities (with consultation from UDOT Planning and relevant MPOs), and determining project priorities (with consultation from regional directors and project managers). They are charged with providing project managers with the resources they need to deliver projects. Program managers are also responsible for tracking program metrics. UDOT policy has been



Source: UDOT

Figure 22. UDOT regions and districts.

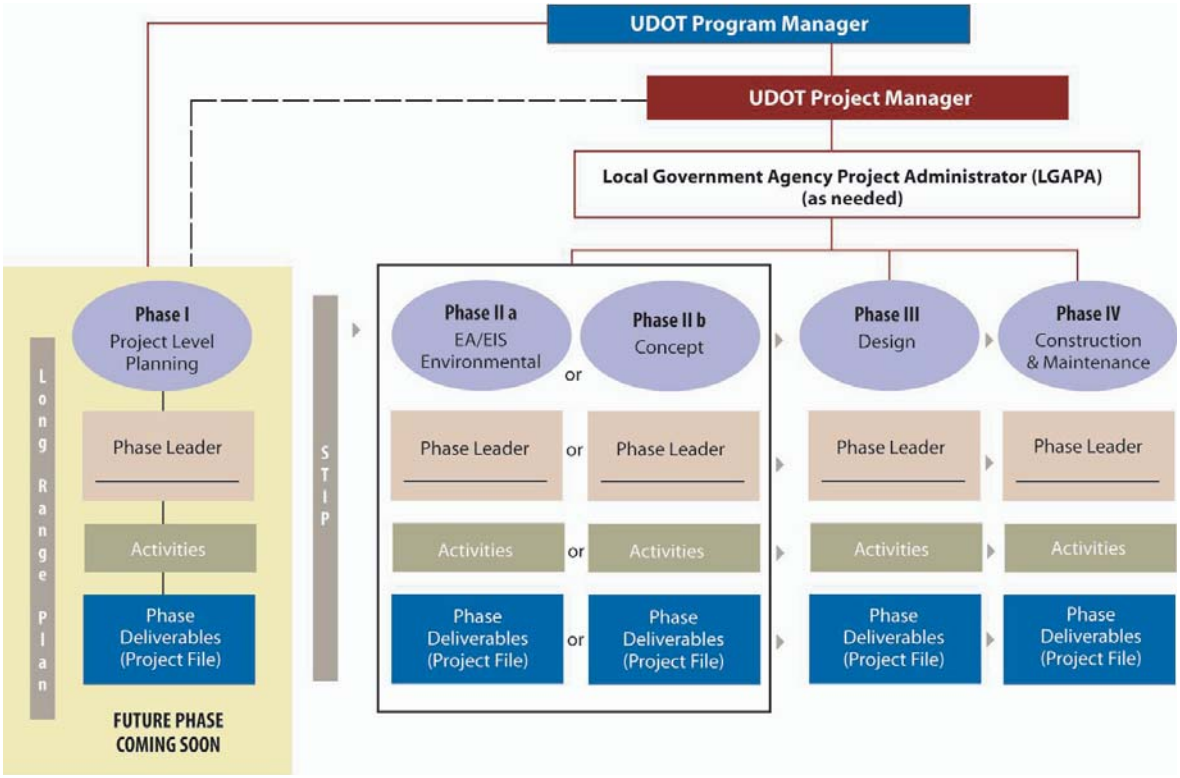


Figure 23. UDOT project delivery chart.

to promote program managers from within UDOT, so that each program manager has spent time as a region director.

The program manager position was created in the early 2000s. In UDOT's funding environment, where the department is reliant on state funding, the program manager is accountable to the state legislature. According to UDOT staff, the position has created greater accountability at high levels within UDOT. However, some feel that there has been a tendency for accountability to accumulate at those high levels and diminish at lower levels. In this regard, it is felt that the creation of these positions has not had an appreciable impact on the speed of project delivery.

UDOT has sought a strategy to centralize functions requiring a high degree of technical knowledge. For instance, staff at UDOT headquarters in Salt Lake City performs functions relating to structures, right-of-way, hydraulics and geotechnical engineering for projects statewide. Functions that require more local or on-site knowledge or significant field time have been decentralized and are performed by regional staff. Examples of these functions include project management, roadway design, utilities, and construction.

High-level UDOT staff feel that decentralization of those functions is a strength of the department because the local leadership can build projects quickly with all or a majority of the required resources under their control. It is believed that this decentralization has assisted with project acceleration. One possible downside suggested regarding this decentralization strategy is that when the central office wishes to pursue an innovative procedure, local staff may not be receptive. Resistance to innovations has stemmed from associated costs as well as from the tendency of the local staff to perceive these initiatives as intervention.

As a means of linking centralized and decentralized functions, UDOT has implemented a proprietary software tool called Electronic Program Management (ePM) for scheduling, tracking, and monitoring program management. The tool is used by all staff involved in project delivery. The STIP is logged into this system as well. Through sophisticated algorithms, the program tracks and prioritizes critical steps in project delivery and allocates staff time accordingly. Timesheets are logged into the system and budgets are tracked. The tool brings a systems engineering approach to program management.

UDOT reports that the ePM system can be a valuable scheduling tool and in many instances does produce a streamlined, efficient project and program schedule. However, the system requires high-quality data and diligent upkeep throughout the project delivery process. UDOT has found that with a

large number of individuals using the system, faulty data inputs are frequent and can hinder the efficacy of the tool.

At UDOT, perhaps because of the funding mechanisms in place, the emphasis on project acceleration is strong. Access to legislators who allocate funds allows UDOT to reduce time spent on programming. Political pressure from those same legislators creates an incentive to deliver projects quickly.

Best Practices for Utah

Background

UDOT has demonstrated a willingness to experiment and take on risk in virtually all facets of project delivery. Its three-pronged procurement strategy exemplifies this willingness to experiment. The department currently uses design–bid–build, design–build, and construction manager–general contractor (CMGC) models. Over the past 20 years, the department has shifted from primarily using the traditional design–bid–build procurement model to primarily (in dollar terms) using a design–build model. Now, the department is attempting to build on the strengths of design–build by entering into an agreement with the FHWA to implement and evaluate a pilot CMGC procurement model.

Under this agreement, federal funding is authorized for 24 projects over a two-year period starting in 2006. Utah has agreed to fund an additional 24 projects—6 projects in each of the UDOT's four regions—to test the model in geographically diverse settings. UDOT has agreed to report to the FHWA on a variety of criteria, including budget analysis, schedule analysis, design, and constructability feedback. Though implementation of the model is somewhat limited, there have been some preliminary findings that indicate that this model could be a useful tool for project acceleration and budget savings. (*108*)

Implementation of the CMGC model is consistent with UDOT's efforts to engage the construction and engineering industries. UDOT's efforts have included regular outreach and consultation with industry representatives, such as the state's Association of General Contractors and the American Council of Engineering Companies on issues such as RFP language. The department has used input solicited through this outreach to inform the contract formulation process and refine the contractor selection process. These groups are not involved in the process of writing specific contracts, but rather provide general guidance on what will make projects biddable. UDOT has made efforts to standardize RFP language based on this input and successes from past projects.

Outside of UDOT, the CMGC procurement method is not generally well understood and is not often employed. In some locations, there are legal barriers to its use. UDOT's use of the method is one of the largest applications of CMGC contracting and thereby contributes to the definition of the method. In UDOT's model, a contractor is selected as early as possible, though the local FHWA office does not permit this selection to take place until after the approved environmental review documents are signed. (*109*)

The Model

Initially, a design consultant is selected. Then, a construction contractor is selected. CMGC contracts are not awarded on a low-bid basis. Rather, the selection process incorporates technical merit and price into a best value formulation. Contractors are evaluated on criteria ranging from design skills to delivery schedule. Once a contractor is selected, that firm appoints dedicated design staff to the project. UDOT then works in cooperation with the design consultant *and* the contractor's designers to achieve the desired design.

The design team works in a collaborative and iterative fashion. For example, UDOT will inquire what would be required for an accelerated schedule or to implement a given innovation. The contractor's design representatives provide feedback regarding constructability and cost for suggested design parameters. The design changes repeatedly, based on identified risks to the schedule or budget.

When the design is finalized, the relationship with the contractor is severed. That contractor is then offered the first opportunity to bid the construction. UDOT simultaneously hires an independent auditor/contractor (usually a seasoned individual retired from the industry) who also submits a blind bid. If the two figures are close and reasonable, the contractor retains the job and enters a construction agreement. If the contractor's bid is not within 10 percent of the independent bid, then the project becomes a traditional bid–build project. (*108*)

Early Findings

In terms of project schedule, the CMGC model does appear to reduce the time frame for most projects. Involving a contractor in the design process creates efficiency in several ways. First, during the design phase, having a contractor provide feedback in real-time allows for earlier identification of design errors and quicker problem solving. The transition from design to construction phases is also hastened and smoothed as the contractor already has detailed knowledge of the design. It has been found that there is less need for specificity and greater ease of communication between UDOT and the selected contractor. (*108*)

The UDOT experience has also shown that this model allows for a project to begin with a degree of risk that would be considered intolerable under other procurement methods. In one instance, design began before ROW issues had been resolved, and the two processes occurred in parallel. That project fin-

ished a year ahead of schedule by eliminating the time that had originally been allotted for ROW acquisition. (*108*)

The CMGC model has been found to enhance working relationships with external agencies. Utility and railroad companies have shown greater openness to solving ROW or relocation issues when a familiar contractor is performing the work. This has again allowed for parallel processes in which these issues can be resolved alongside the design phase, thereby decreasing the overall project schedule.

Change Orders

UDOT hoped that the CMGC model would reduce overall costs for a project. One of UDOT's primary goals for initiating the pilot program was to test if the model would reduce the number of change orders. The department had identified change orders related to design errors as a significant source of inefficiency with regard to both cost and project delays. By involving the contractor in the design process, design errors were expected to be caught early and contractors expected to absorb the risk associated with those errors.

Early indications are that the model has indeed reduced the number of change orders related to design errors. However, UDOT frequently utilizes change orders to expend funds that are either freed by negotiations or legislatively allocated. UDOT employs change orders for this purpose on all projects, regardless of contracting method. This procedure, in turn, complicates the analysis of the impact of the CMGC arrangement on change orders and overall budget. It requires analysis on a project-by-project basis, which has not yet been completed by the agency. (*108*)

The Design Process

There has been consensus between program managers and Association of General Contractors representatives that this contracting method has resulted in reduced risk, improved design, and shortened project schedules. It is believed that the better design stems from UDOT's active involvement in the design process. In a design–build model, the department cedes design control to the contractor. In that process, the contractor is motivated to maximize profits. That objective may run counter to accelerating the schedule, developing a high-quality design, or pursuing innovation.

In the CMGC model, the contractor is part of the design process insofar as providing feedback on constructability and cost, but UDOT staff guides the use of innovative techniques. The contractor advises on construction, and the design team tailors the design to fit the contractor's strengths and abilities. While the contractor does not have the same kind of control as in a design–build contract, the design team still strives for a design that the contractor will be able to construct deftly. (*108*)

Having the contractor involved in the design process also opens the possibility for parallel phases. As long lead items are identified, the contractor can begin procuring before the design is complete. Additionally, if innovative methods are employed, early involvement provides the contractor with additional time to learn and develop familiarity with the task. (*108*)

Lessons Learned

UDOT found that though CMGC projects do benefit from shortened schedules, it is not the best contracting method to use if there is a considerable time restraint and an abbreviated schedule is the principal driver. When schedule is the primary driver, the project manager and the contractor tend to place pressure on the design consultant to speed the pace of design. This pressure can increase the likelihood of design flaws going unnoticed. Also, there have been experiences where early-phase contracts for materials have resulted in multiple change orders and increased construction costs. In instances where schedule is the primary driver, UDOT recommends using a design–build model.

Project and program managers at UDOT believe that the greatest gains in schedule under the CMGC model are derived from the ability to perform tasks on a parallel schedule. Customarily, design takes longer because of the iterative nature of the process. Some acceleration occurs in construction due to efficiencies created by the contractor's familiarity with the design. However, the greatest acceleration is achieved by the ability to perform parallel scheduling. One caveat is that parallel schedules do increase risk; therefore, the model should not be employed in a risk-adverse environment.

UDOT found that an advantage of CMGC over design–build is that it is simpler to select a contractor. Where design–build procurement can require a 500-page RFP, a CMGC RFP can be as brief as 25 pages. By retaining control of the design process in a CMGC contract, UDOT can greatly reduce the need for specificity in the RFP language. For contractors, the cost of responding to a CMGC proposal request can be a tenth of the cost of responding to a design–build RFP.

Defining roles and responsibilities has proven to be an important task in CMGC projects, as many in the construction industry are unfamiliar with the model. UDOT has begun partner training at the onset of a project to reinforce roles and responsibilities. The department has found that one benefit of the model is the spreading and sharing of risk. In the conventional design–bid–build model, the department owns the risk; in design–build, the contractor largely owns the risk; in CMGC, risk is distributed and shared, thus creating accountability for all the project delivery partners.

The department also found that cost must be considered throughout the process. UDOT expressed concern that some contractors may try to exploit the first bid opportunity for

construction. It is important for the contractor to know that if it cannot deliver the project for a fair price, the project will revert to a bid–build model.

Future Developments

Recent months have seen great uncertainty arise in the realm of transportation funding all across the United States. States from coast to coast are finding significant funding shortfalls as tax revenue drags with the overall economic slowdown. Adding uncertainty in the coming year is the reauthorization by the U.S. Congress of a federal transportation bill. This bill has been speculated to feature significant alterations to funding formulas and mechanisms.

At this time, the funding outlook for Utah is difficult to estimate. The state's heavy reliance on State funds for capacity building projects further clouds the ability to forecast. It is unclear whether this model will fare better or worse than states that rely more heavily on federal funds. In the past few years, UDOT's efforts have been well funded, but the needs continue to outpace resources.

According to senior UDOT staff, an estimated 70 percent of transportation dollars are being spent in design–build projects. That figure is likely due to the design–build model's proven record of accelerating project schedules over the traditional design–bid–build model. If the CMGC model continues to demonstrate real project acceleration benefits, this contracting method is likely to gain greater prevalence at UDOT.

Conclusions

UDOT does recommend CMGC as the primary delivery process when schedule is not the primary driver. Its CMGC pilot projects seem to indicate that the contracting method can be an effective tool for accelerating projects. However, the UDOT's efforts have been conducted in an environment where there is active engagement and cooperation between the DOT and the construction industry. UDOT's persistent outreach to the state's Association of General Contractors may lay the groundwork for a unique mutual trust between the department and participating contractors. In other environments, where contractor–transportation agency relationships are less amicable, such a contracting method may prove counterproductive.

In addition to project acceleration, the CMGC contracting method has a number of co-benefits. Specifically, UDOT has found the method is less intensive on the front end, with less effort required to prepare an RFP and contract documents. Additionally, the model grants the agency significantly more control in the design process and allows UDOT to pursue innovations as it sees fit. This trait could help to drive innovation in Utah and around the country.

CHAPTER 6

Implementation and Suggested Research

Implementation

One intent of this research is for other states to learn and selectively adopt some of the identified best practices, and either incorporate them into their core strategies or simply improve an aspect of their operations or organizational structure. Over time, any small improvement may assist in delivering projects sooner, providing efficiencies in other areas (budgets, schedule, strategy, etc.) that may not have been present before. Making this report available to state DOTs will greatly enhance their knowledge base of how a state DOT can make transformations to reach new plateaus of performance. The following strategies can help disseminate this information through various formal and informal channels:

- **Publication in professional journals**—Parts of the report or a summary may be published in professional journals such as *TR News, Civil Engineering, CE News,* and *Roads and Bridges.* Given the eight case studies, the information could be presented as an eight-part series in a number of ways.
- **Presentation at transportation conferences**—Numerous conferences are held throughout the year for transportation professionals. Presentation of these research findings can be presented at AASHTO and TRB conferences. Other types of transportation societies such as the American Society of Civil Engineers and American Society of Highway Engineers hold national conferences where new ideas, innovations, and methodologies are topics of discussion. These venues provide opportunities to learn about new and developing research.
- **Local transportation associations**—Local chapters of the national societies mentioned previously also hold presentations and meetings. Informal discussion of the report is one way to encourage more formal distribution of the report. Grassroots transportation/engineering organizations may present some opportunities for additional informal discussions on the topic.
- **Websites and webinars**—Transportation websites offer more flexibility than other media for acquiring the latest news. The TRB website can post an article on this NCHRP report. The FHWA press releases can include an article about the NCHRP research or provide a link to a report summary. The state transportation agencies included in the case studies can make reference to this report on their own websites, and encourage upper management and key decision makers to read the report. Webinars are another option for distributing information about the research. Groups or individuals can log on at their computers to a webinar or series of webinars that discuss topics on a holistic approach to accelerating program and project delivery.

Suggested Research

Data Collection, Baselines, and Benchmarks

Throughout the interviews with the states, one of the things that the research team requested was some form of quantifiable data that could provide a measure of how much improvement in time the state DOT had experienced. For instance, if a state noted that it was able to deliver a project quicker because of a new process, it was asked how it measured that result and what the baseline duration was prior to implementing the new process. If a state noted that a new method reduced the timeline and the budget, the research team requested data regarding the reduction in time frame as well as how much the project came in under budget.

Many states could provide some type of data that measured a small facet of the project, but very few states could provide a continuous stream of information that measured most aspects of their programs or projects. For example, design costs were available, but planning costs were difficult to ascertain because of the nature of the planning process, which requires exhaustive efforts in collaboration, coordination, and community outreach. While the construction cost for a given project was

easy to obtain, a baseline to measure it against was not. An inventory of roadway data might exist within a state database—but no tool was in place to apply them on a system-wide basis. A state might have had information on one aspect of a project phase, such as the cost of construction, but not on another phase, such as the cost of environmental permitting.

While this is such a broad topic to explore, many states have only begun to collect relevant information and set baselines. For such states, the passing of time will determine how they will use the data they are collecting today. Additionally, there is a lack of consistency in the data that is gathered. Each state must decide what data to collect and what purpose it will be used for. No two states share the same ratios of state-operated roadway miles per capita, per budget dollar, per VMT, or per square mile of area. This diversity of baseline data makes it difficult for researchers to get a better grasp of the programs' and projects' efficiencies from a purely numerical perspective. Research is recommended in the types and level of data collected, their purposes and uses, and applications to current systems and decision making.

Public–Private Partnerships

In all cases, the reality of limited funding sources cannot be ignored. States continue to operate under the challenge of doing "more with less." Some state DOTs have maximized their options for federal loans and bonds and must seek alternative funding mechanisms. Common to a number of states is the use of PPPs. While PPPs require an allocation of risks, resources, and rewards, and collaborative efforts between state and private entity, such arrangements offer benefits that might otherwise not be realized. Success stories or lessons learned from states that have experienced PPPs should be developed into case studies and published. This may open up additional avenues for a state to explore as a means of shared revenue sources.

Procurement Policies

Many states are considering changes in procurement policies and strategies to accelerate projects and programs. These policies often have deep rooted state and federal rules and regulations that make change difficult. The concept of a single project manager that sees a project though from its initial ideas and concepts to the actual implementation and opening is now being considered by many states to provide a single source of contact and project team leader. The corollary to this concept is the idea that one multidiscipline engineering/planning firm is hired for all tasks from concept to completion. Procurement rules often prohibit this strategy in order to provide additional procurement opportunities or because of concerns that consultants will purposely consider larger projects to raise fees and revenue expectations for their firms.

Considering new and innovative procurement options with well-thought-out scopes that require documentation of performance measures and costs may be a step to help accelerate projects and to better track and provide a detailed accounting of holistic project details.

CHAPTER 7

Conclusions

The highway transportation industry in the United States has evolved rapidly over the last 60 years. Thirty years of indefinite expansion and new construction, followed by years of heavy use and maintenance, have brought it to a state where overhaul and costly maintenance or replacement is now called for. Some states are still expanding their existing networks, but not with the vigor that characterized the late 1950s and 1960s. The parabolic bridge profiles and endless miles of highways that came together to create the visual and symbolic landscape that is iconic of the American interstate system are in need of repair.

As that same network is aging, every state is embracing innovative, cost effective ways to extend the useful life of their respective system of roads and bridges. Confronted with an aging infrastructure, the catalyst driving states to maintain and preserve their infrastructure assets lies in the financial constraints that transportation departments are experiencing. Additionally, the loss of tacit knowledge through retirements, an ever increasing population with greater mobility needs, chronic congestion, and rapidly increasing VMTs press upon them the need to accelerate programs and projects from conception to completion.

Several state DOTs have taken a broader approach to delivering programs and projects. Their task is even more difficult in today's environment. They must combine modern means with an organic approach to preserve both infrastructure and environment. It is hard not to be impressed by what DOTs have accomplished by expanding on smaller successes, combining winning strategies, and taking a holistic approach to delivering projects. This research has illuminated the best practices developed and implemented by states in their endeavor to take an idea from concept to completion.

In California, the concept of a performance-based management program incorporates a strategic plan, operations plan, and actual performance measures. The outcome-driven results provide an assessment of Caltrans' system and the product that Caltrans is delivering to the public and stakeholders. Its goal is to strive for 100 percent delivery of scheduled projects every fiscal year. At the same time, under CEQA (California's NEPA delegation), Caltrans has been able to reduce the time required to obtain approved environmental documents.

In Maine, a comprehensive bridge tracking program monitors safety, environmental compatibility, functionality, and overall quality of bridges. A team approach has significantly helped to accelerate programs through commitment, shared responsibility, risk taking, and accountability.

Maryland SHA's best practices focus on performance measures for the agency's six modal administrations. The publication of the Annual Attainment Report encompasses the health of its infrastructure and sets new targets for the coming years. Considered to be the leaders in CSS, MDOT incorporates CSS as a standard operating procedure. Acceleration is also accomplished through environmental streamlining and design–build delivery systems.

MoDOT's unique organizational structure emphasizes three separate wheels for system delivery, organizational support, and system facilitation. A bipartisan Transportation Commission provides balanced decision making on all transportation issues. However, Missouri's *Tracker* measures the department's internal and external organizational effectiveness. Accountability of "drivers" for and transparency of results create the momentum for continuous monitoring and constant improvement of their benchmarks.

In New Jersey, pipelines for project delivery selectively map the activities of a project based on its complexity and characteristics. Acceleration is achieved through a customized, well-scoped project that follows a defined process and network logic. A project management philosophy guides the project managers in how projects are initiated, planned, executed, monitored, and closed. New Jersey's future lies in asset management involving policies, programming, and program delivery based on implementing a performance measurement system.

In North Carolina, a creative realignment provided the direction for future vision, strategy, and employee engagement. Those efforts culminated in streamlining project development and delivery through concurrence. The Merger 01 process, a multiagency initiative, seeks to formally register the concurrence of all concerned parties at strategic points in the development of a project, from the earliest conception and planning phases. North Carolina's organizational performance dashboard also provides a set of gauges that are linked to a performance management program.

Texas has experimented with innovative financing tools and contracting methods. Procurement strategies such as evergreen contracts, which pre-qualify contractors to perform specific types of work, have helped TxDOT accelerate smaller projects. Its comprehensive development agreements allow a given contractor to perform all services of a project from design and construction to maintenance and operation.

In Utah, the best practice is a pilot contracting program called construction manager–general contractor. This innovative approach involves a design consultant and a construction contractor to collaborate on a project early on. Involving the contractor during the design process allows constructability issues to surface and opens greater possibilities for parallel processes to occur.

Programs that incorporate performance measures; continuous improvement processes; pipelines to project delivery; collaborative advances to communicate ideas; cooperative efforts; project management principles; integrative ideas that encompass holistic processes; continuity in leadership; and changing policies at federal, state and local levels are just some of the ways that states are responding to the demands of a new climate in transportation. Such programs, which move toward common end goals, are in effect accelerating programs and projects from conception to completion, using a combination of techniques and proven methods to bring facilities to the public more quickly. States now practice a very rational method of planning and designing in which single or multiple tracks of a process, under challenging scenarios, have opened up many dimensions of creative opportunity.

States have also undergone some shifts in DOT culture. Paradigm shifts have occurred in the way that departments do business. New skill sets, new ideas, and new relationships have been developed through the course of these shifts. Accountability and transparency are the new mantras that require state DOTs to perform a candid self-assessment and then engage in setting benchmarks, targets, and higher goals at all levels within the organization.

All the states studied, through their evolution, have allowed us to gain insight to what is possible given all the limitations, funding challenges, and aging infrastructure. These states demand more of themselves and challenge the boundaries of current processes, policies, and practices to strive for excellence. That excellence is evidenced in the built environment.

Acceleration does not have to come at a high cost. States have achieved accelerated delivery through up-front planning, well-defined scopes, organized processes that outline tasks and responsibilities, accountability and transparency for one's work, intense community outreach efforts, and innovative contracting, all before the monumental ground breaking. New managerial methods, coupled with technological advances, allow transportation professionals to make balanced decisions resulting in smoother process execution and, ultimately, quicker program and project delivery.

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Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation