Effective Program Delivery in a Constrained Fiscal Environment

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TABLE OF CONTENTS

1. INTRODUCTION: PURPOSE OF THE STUDY

1.1 BACKGROUND – PROBLEM STATEMENT

During the Interstate-building era, state department of transportation (DOT) program delivery functions were fairly straightforward. For the most part, state agencies worked with the Federal Highway Administration (FHWA) to plan facilities, determine funding needs, and set construction schedules. Projects were developed and constructed on a pay-as-you-go basis; FHWA reimbursed states for 80 percent to 95 percent of project costs; budgeting focused on ensuring federal funding did not lapse; and large cash balances, cost overruns, or project delays while not uncommon were not considered a major problem.

State DOT program delivery has become much more complex in recent years. Today, DOT managers face new challenges and requirements with respect to 1) delivering projects on time and on budget, 2) distributing funding efficiently and equitably, 3) developing projects in a manner that protects the physical and social environment, 4) managing (and leveraging) resources as efficiently and effectively as possible, and 5) including other agencies, interest groups, and the public in project prioritization and funding decisions. With these new challenges, it is no great surprise that states are having difficulty programming, budgeting, and administering realistic, politically viable, and financially-constrained transportation programs.

Effective program delivery is achieved through the establishment of sound policies and procedures that address the management of projects throughout the project and program delivery process. It is a state of practice that transcends individual project phases and provides a continuum of sound management throughout the life of a project – and a transportation program. There is a wide variation, however, in the management approaches, systems, and tools being deployed by state departments of transportation. While some states are known for use of highly integrated approaches, many still rely on informal and fairly unstructured methods.

There are a number of driving forces to the increasing importance of more systematic approaches to program delivery. These include forces, or influences, within each of four broad program function areas, as follow:

- **Identifying Priorities** – While states have always faced constrained funding, the constraints are even more profound today. States also are being held to a higher standard of accuracy in what they promise, requiring that they more carefully prioritize program needs and actions.
- **Obtaining Resources** – New revenue sources, finance mechanisms, and grant management techniques require more sophisticated market analysis and greater knowledge of their flexibilities, restrictions, and long-term program implications. With the anticipated advent of new techniques, knowledge of these approaches will become even more critical.
- **Delivering the Program** (note: this functional area has been renamed and expanded from "Redefining Roles" in original NCHRP project statement) – To deliver larger programs

with smaller staffs, DOTs are turning more to outsourcing and other techniques that require development of human resource management systems beyond the traditional state agency program delivery approaches of the past. Also, many state DOTS are decentralizing or delegating project selection, project development, and project financial management responsibilities, expanding the number of staff who require expertise in project prioritization techniques, innovative finance options, and financial management.

- **Managing Finances** – With greater use of debt financing and greater project complexity, states require more sophisticated administrative programs and new types of staff expertise to oversee both the cost management and funding aspects of program delivery.

Together, the forces acting in each of these four functional areas contribute to the challenge of planning, programming, budgeting, and administering viable fiscally-constrained programs.

To date, there has been limited focused documentation of what states are doing to address these forces, including development of new tools, processes, and management approaches. Nor has there been comprehensive documentation of the gaps in current practice and associated tools. There is, therefore, a need for a broad "50,000 foot view" of how the various pieces fit together, what is missing, and how best to address the identified gaps.

1.2 OBJECTIVES AND REPORT STRUCTURE

The objective of this study was to develop a comprehensive understanding of the driving forces that have contributed to difficulty in program delivery in today's constrained fiscal environment. In support of the overall study objective, the specific objectives were: 1) to define and describe the forces of change and associated impacts on program management and delivery; 2) to document the state of the practice among state DOTs, including gaps that may exist in tools, techniques, and management processes to support program delivery; and 3) to make recommendations regarding topic areas for further research.

In fulfillment of the study objectives, the remainder of this interim report is dedicated to:

- More fully discussing the forces of change across the four broad functional areas of 1) identifying priorities, 2) obtaining resources, 3) delivering the program, and 4) managing finances **(*Chapter 2*)**;
- Documenting current tools, techniques, and management processes deployed by state DOTs to respond to these forces of change and identifying gaps in the state of the practice **(*Chapter 3*)**; and
- Highlighting promising new and emerging practices and offering recommendations for Phase 2 study of noteworthy practices and lessons learned **(*Chapter 4*)**.

An appendix to the report provides an inventory and synthesis of the most relevant literature as it relates to understanding the forces of change as well as the state of the practice.

1.3 PHASE 1 METHODOLOGY

To meet the objectives of this phase of the study, the research team followed a multi-pronged approach that included an in-depth review of the relevant literature, outreach to state DOT officials and other industry leaders, and application of the research team's own experience and expertise to develop a comprehensive accounting of the forces influencing the four identified areas of program delivery management, the current state of the practice, and gaps in the tools, techniques, and strategies, with an aim toward identifying the most promising areas for further study.

1.3.1 Literature Review

To supplement direct research, the research team conducted an in-depth review of the relevant literature. Results of the literature review are incorporated throughout this interim report and also included in a comprehensive synthesis as an appendix to the report.

Given the cross-cutting nature of issues associated with program delivery in a constrained fiscal environment, the research team cast a wide net for potentially relevant literature, including reports and studies that directly or indirectly address the following topics – either individually or in combination:

- Strategic Planning
- Long-Range Planning
- Programming
- Asset Management
- Performance Measurement
- Economic Benefit/Cost Analysis
- Transportation Funding and Finance
- Financial Management Practices
- Public-Private Partnerships
- Outsourcing and Alternative Procurement
- Project Management
- Organizational Change
- Human Resource Management
- Public Involvement

The research team concentrated on literature that identifies broad trends rather than on individual mechanisms or experiences of single states.

The research team focused the literature review on the following sources and body of material:

- **Transportation Research Board (TRB) and National Cooperative Highway Research Program (NCHRP)** – including reports, circulars, e-circulars, syntheses, conference proceedings and presentations, and web documents;
- **Federal Highway Administration (FHWA)** – guidance, primers, subject matter reports, and web pages;
- **American Association of State Highway and Transportation Officials (AASHTO)** – reports, conference presentations, and web pages;
- **Government Accountability Office (GAO)** – reports to Congress; and
- **Universities and Other Research Organizations** – relevant reports and studies.

The research team also reviewed bibliographies of other reports to identify additional relevant material and familiarized itself with the potentially relevant resources available beyond the

transportation field, such as those of the Government Finance Officers' Association (GFOA), independent rating agencies, and associations of state government (e.g., National Conference of State Legislatures, National Governors' Association, National Association of State Budget Officers). While materials from these organizations are not included directly in the literature review, it is anticipated that they will be important resources to the research team in Phase 2 of the study, depending on the topic areas chosen for further study.

1.3.2 Outreach

Concurrently with the review of relevant literature, the research team conducted interviews and informal discussions with a wide range of industry participants. This outreach effort included discussions with the following:

- **Current and Former State DOT Officials and Staff** – including from Colorado, Florida, Illinois, Indiana, Kansas, Kentucky, Maryland, Mississippi, Missouri, New Hampshire, North Carolina, and Virginia;
- **FHWA and FTA Staff**;
- **Leaders and Staff of Relevant Industry Organizations** – including the American Association of State Highway and Transportation Officials (AASHTO), the American Road and Transportation Builders' Association (ARTBA), and the Association of Metropolitan Planning Organizations (AMPO);
- **Individual Members of the Project Panel**; and
- **Other Consultants** – including from other firms as well as additional staff from within the research team's organizations with relevant experience and expertise.

The research team also attended relevant national conferences and collected materials from these conferences that were of relevance to this study. Examples included: the Annual Transportation Research Board meeting; the Joint Summer Meeting of the TRB Planning, Data, Finance, Administration, Freight, and Management Committees; the AASHTO Annual Meeting, several individual committee meetings, and the Project Finance Institute; the Second National Conference on Performance Measures in Transportation; and the Southern Transportation Finance Conference. Results of the outreach efforts are incorporated throughout this interim report and help to form the foundation of recommendations for Phase 2 research.

1.3.3 Synthesis

Following completion of the literature review and outreach efforts, the research team worked to synthesize the research results, applying team member's individual knowledge and experience and with a special focus on providing real-life examples of the research findings, considering the implications of passage of the newest federal highway authorization – the Safe, Accountable, Flexible, Efficient, Transportation Efficiency Act – a Legacy for Users (SAFETEA-LU), and developing recommendations for focusing on the highest and best value topic areas for Phase 2 of the study.

2. FORCES OF CHANGE IN PROGRAM DELIVERY MANAGEMENT

2.1 INTRODUCTION / OVERVIEW

The forces of change in transportation program delivery management are complex, characterized by significant interrelationships among the forces as well as the functional areas upon which these forces act, and have both positive and negative impacts. This chapter first highlights the symptoms of the need for change and for new tools and techniques to address past and ongoing changes. It then reviews specific forces or influences identified as being key drivers to transportation program management, across the four functional areas:

- **Identifying Priorities** – which, for the purposes of this study, includes the program management disciplines of strategic planning, long-range planning, programming, asset management, performance measurement, and economic benefit/cost analysis;
- **Obtaining Resources** – including program management functions related to securing federal funding, raising state revenue, attracting private and local financial participation in states' transportation programs, and leveraging these sources through the application of capital market financing;
- **Delivering the Program (Redefining Roles)** – while the title of this category is quite broad, this study focuses on program management elements related to the choice between and impact of in-house delivery and outsourcing and the distribution of management responsibilities among divisions of the DOT, outside advisors, and contractors; and
- **Managing Finances** – including the administrative functions associated with managing an increasingly complex pool of financial resources, including debt management, cash management, and cost estimation and control mechanisms.

2.2 SYMPTOMS OF NEED FOR CHANGE AND FOR NEW TOOLS AND TECHNIQUES

Over the years, the transportation industry has put significant energy and resources into improving the way transportation programs are planned, managed, and delivered. These efforts have yielded great improvements in critical areas such as long-range planning, project development, asset management, and finance. Despite the many advancements, several symptoms – highlighted below – point to the need for additional or improved program management and delivery tools and techniques.

2.2.1 Strategic Priorities Detached from Program Delivery

While many states have begun to spend greater energy on creating strategic plans and articulating the organization's goals and objectives, these plans are still too often created in a vacuum and with only limited bearing on the actual day-to-day business of the organizations for which they are theoretically setting strategic direction.

2.2.2 Multiple but Not Integrated Strategic Initiatives

State DOTs have made significant advances in formulating and applying strategic-oriented initiatives. These generally occur in the areas of performance measurement, strategic planning, long-range planning, and asset management. These efforts, however, tend to be largely uncoordinated, overlapping, and even at times contradictory to one another. They generally operate in their own worlds with little systematic effort to align them with one another.

2.2.3 Planning and Program Delivery Disconnects

Transportation system planning refers to a broad range of activities that include statewide and metropolitan long-range planning, medium-range planning, special program planning, and corridor planning. In theory, the common characteristic of these various activities is that they should provide a basis for policy, program, and project decision-making. In practice, however, agencies often treat system planning and program delivery in isolation, with little coordination between the two. Examples of areas where this disconnect can lead to inefficiencies and/or problems include:

- **Program Development** – Agency programs may be established or revamped based on state or federal mandates, political considerations, or other influences that are inconsistent or incompatible with plan goals and objectives;
- **Resource Allocation** – Legislative requirements, political pressure, and/or historical precedent can lead to or perpetuate allocation practices (e.g., geographic, modal, etc.) that do not reflect plan priorities; and
- **Project Prioritization** – Planning personnel often are not involved in programming functions and have limited interaction with agency staff that has responsibility for project selection. Also, the processes and criteria agencies use to identify and select projects frequently are not revised to reflect new plan priorities.

2.2.4 Poor Pipeline Controls between Project Development and Programming

Many DOTs find themselves with one of two problems: too many projects sitting on the shelf awaiting funding – and in some cases becoming outdated or obsolete in the meantime – or too few projects ready to go. The latter problem can manifest itself when a particular project must be delayed for some reason and a state finds itself without alternative projects that are ready to go in its place. It is a delicate balance that must be maintained and states do not always have adequate (or sometimes any) mechanisms in place to manage the balance.

2.2.5 Over-Programming

Programming is a critical program delivery activity. For many agencies, it is the first time that they commit to deliver individual programs and projects on a specified schedule and for a defined cost. At the time projects are programmed, however, limited information may be available about factors that influence the risk associated with project cost, scope, and schedule estimates. Programming processes thus require a combination of science and art to balance between building in sufficient cost contingencies (i.e., over-estimating program and project costs) and placing enough projects into the delivery pipeline (i.e., over-programming) to ensure scarce resources will not lay idle due to project development schedule slippages or unforeseen circumstances.

Many transportation agencies recently have run into significant problems with the accuracy and legitimacy of their programming processes. Over-programming causes, such as funding cutbacks, overly optimistic revenue and cost forecasts, greater project development complexity, legislative

mandates, and/or unrealistic schedules have led to situations where many agencies are severely over-programmed and fail to deliver on the commitments they have made. As a result, agencies now find themselves in one of the following categories with respect to their need to "re-program" to reflect current revenue and project cost realities:

- **Agencies with Balanced Programs** – A limited number of agencies have not experienced major budget shortfalls or have taken particularly conservative approaches to programming (thus no need for re-programming).
- **Agencies Requiring Minor Changes** – Many agencies have dealt with their programming issues through minor adjustments, such as breaking projects into additional phases or by sliding projects out a year or two.
- **Agencies Requiring Major Changes** – A few agencies have recognized the need to significantly scale back their programs by postponing or de-programming projects.
- **Agencies in Denial** – several agencies are over-programmed (either in STIPs/TIPs or project-specific plans), but have yet to formally recognize and/or try to address their problem.

2.2.6 Challenges Delivering Special Programs and Mega-Projects

Over the last two decades, a number of states have tied transportation funding increases to the implementation of special construction programs – often for building new four-lane highways. In many instances, these programs have created significant program delivery challenges for transportation agencies that include the following:

- **Cost Overruns** – The original cost estimates for completion of many of these programs have proven significantly low, leading to stakeholder and citizen perceptions that the program overruns are due to mismanagement by the responsible agencies.
- **Schedule Delays** – In part due to cost overruns, but also resulting from the increased complexity and requirements associated with project development, a majority of special construction programs experience significant delays.
- **Program Rigidity** – Special construction programs frequently are comprised of projects and facilities that were selected and promised to the public more than a decade ago. In many cases, the project comprising the program and the dedication of specific funding has been established through legislation. As a result, agencies may have limited ability to change the projects within a special program or shift dedicated program resources to newly emerging priorities.

The proliferation of mega-projects (e.g., projects over $500 million) is creating project delivery challenges similar to those associated with special programs. As exemplified by Boston's "Big Dig" and Virginia's "Mixing Bowl," large projects tend to include a high number of unknown factors that increase the risk for scope creep, cost overruns, and schedule slippages. When project costs escalate and schedules slip, agencies are typically left with little option other than to shift resources from other priorities and programs. Because of both the enormous cost and the high degree of risk associated with these types of projects, many agencies have avoided starting them, but have reached (or will soon reach) a point where addressing the needs can no longer be delayed.

2.2.7 Excess Cash Balances and/or Dangerously Low Balances

While it is instinctive to focus on the concern of having too little cash on hand, state DOTs actually commonly face the challenge of having both too little and too much cash available. As a symptom of

program management difficulty, both extremes relate directly to several of the program management functions addressed in this study, including but not limited to cost estimation, project scoping, and scheduling. States also can find themselves sliding rapidly from one extreme to the other. For instance, by addressing the underlying program management issues that contribute to excess cash balances, a state can slide precipitously to the other extreme of over-spending (or risking over-spending) resources and having dangerously low balances. Low balances carry with them the risk of over-spending available resources, the inability to pay contractors, the need to slow down or halt projects midcourse, and both the "hard" costs and "soft" (e.g., political) costs of these kinds of adjustments.

2.2.8 Organizational Angst and Staff Attrition

Symptomatic of the difficulties facing state DOTs in responding to external forces and achieving effective program management are internal barriers to experimenting with new approaches. These barriers often relate to the institutional biases inherent of large (governmental) organizations and the collective anxiety that can build up in organizations that are experimenting with new approaches and going through organizational transformations. Staff attrition is another, sometimes related, symptom of the challenges facing state DOTs in responding to external influences and affecting necessary programmatic change. As states lose staff to retirement and competition from the private sector, they find themselves unable to maintain staffs at adequate levels (due to hiring restrictions, budget constraints, and/or competitive markets for qualified personnel) and challenged to train new personnel with limited experience.

2.2.9 Lack of Stakeholder Confidence

A sign of when a DOT has lost its footing as it relates to program management is the level of confidence of external stakeholders in the organization's ability to carry out its mission and core functions. Instances in which a significant lack of stakeholder confidence exists are often symptomatic of deeper issues with program management functions.

2.2.10 Lack of Industry Capacity and Readiness

While the lack of contractor capacity is often pointed to as a cause of problems facing state DOTs and a force constraining DOTs' ability to delivery their planned capital programs, this lack of readiness is actually both an external force and a symptom of internal program management issues. State DOTs have an important role to play in making sure that their industry partners are ready to help deliver planned capital programs – by clearly articulating the state's plans, abiding by those plans, and, when change is unavoidable, communicating that change early and clearly to industry partners. State DOTs also have a role in training industry partners in new approaches associated with program delivery management.

2.2.11 Summary

The symptoms described in this section together demonstrate the range and depth of challenges facing state DOTs as they strive to deliver increasingly complex transportation programs with limited staff and fiscal resources. The next section delves behind the symptoms to develop an understanding of the core causes or forces driving state DOTs to change their program delivery practices in the face of increasingly challenging financial situations.

2.3 FORCES OF CHANGE

Drawing on the symptoms described above, this section discusses specific forces, or influences, that have been identified as primary drivers to changes in transportation program delivery management, across the four functional areas: (1) Identifying Priorities; (2) Obtaining Resources; (3) Delivering the Program; and (4) Managing Finances. Following a discussion of the primary forces of change, this section also identifies barriers to positive change along each of the four functional areas.

2.3.1 Identifying Priorities

The need for transportation agencies to deliver programs in a constrained fiscal environment is not new. Indeed, since the beginning of the highway era, transportation agencies have had to prioritize investments due to the lack of sufficient resources to address all highway expansion and improvement needs. Until the early 1990s, these prioritization activities focused on completing the Interstate System and were largely driven by the highway community – for the most part, agencies worked with FHWA to plan facilities, determine funding needs, and set construction schedules. While these activities could technically be considered "planning" and "programming," agencies treated the resulting plans more as rough schedules and estimates than as hard and fast commitments that reflected budgetary and project delivery realities.

In recent years, the requirements, scope of activities, and environment associated with identifying priorities and incorporating them into planning and programming efforts have radically changed. In short, planning and programming have become much more complex, challenging, and important. The following is a discussion of the forces that are driving these changes and creating the need for better approaches and tools for priority setting.

Growing Investment Demands

The demand for transportation investment is currently growing at a staggering rate, both with respect to the level of needed investment and the range of improvements that citizens and stakeholders are requesting. This, in turn, is placing greater pressure on agencies to optimize their project prioritization and resource allocation practices across both functions (e.g., system preservation, capacity expansion, and operations) and mode. Factors and considerations that are driving or influencing this demand growth include the following:

- **Existing Commitments** – Many agencies have made commitments and/or have mandates to complete major programs or projects. These commitments often tie up significant resources and leave limited funding that can be allocated to address newly emerging priorities.
- **Travel Demand** – The number of vehicle miles traveled on America's highways continues to grow at a fast pace, leading to growing congestion and travel delay. Under these circumstances, where agencies face capacity shortages that they simply cannot address by adding additional highway lanes, traditional, mode-centric prioritization processes may not be adequate to support the development of "big picture" solutions to transportation problems.
- **System Preservation Needs** – Much of the nation's highway system is nearing the end of its design life and agency backlogs for facility renovation, reconstruction, and replacement are growing. As a result, agencies are facing tougher choices about whether to allocate resources to system preservation or new construction.

- **Local Needs –** Transportation system performance is heavily influenced by the quality of local facilities that connect homes and business to core infrastructure such as highways, rail yards, and airports. At the same time, local governments are feeling the same, if not more intense stresses as state DOTs with respect to growing demand for capacity, expanding preservation backlogs, and insufficient resources. Most state DOTs lack the capacity to evaluate local priorities on an even playing field with state and regional investment needs.
- **Project Scope and Costs** – The cost of planning, constructing, and/or procuring transportation facilities continues to grow, due to both general cost inflation and the evolution of scope and requirements associated with providing a given unit of transportation capacity.
- **Freight, Intermodal, and Multi-modal Needs** – The emergence of a more global economy, the evolution in the way businesses use and rely on the transportation system, and growing customer expectations about accessibility and modal choice are all serving to increase the range and cost of transportation improvements that must be considered during planning and programming processes.

Funding Considerations

For most of the transportation industry, funding simply has not kept up with the growth in investment demand, leading to ever-expanding funding shortages. Theses shortages have served to exacerbate the need for agencies to optimize their investment decisions. The shortages also have led agencies to look for new ways to fund projects through inter-jurisdictional cost sharing, innovative finance, and public-private partnerships. As a result, the identification of new funding and financing approaches has become an integral part of program delivery, to the point where the source of funding is becoming an important criterion in project prioritization and selection processes.

Federal Requirements

Federal laws and regulations enacted or promulgated in recent years are having a dramatic impact on both agency priority setting and program delivery. In particular, agencies must now develop both long-range multi-modal plans and fiscally-constrained transportation improvement programs (STIPs/TIPS) that incorporate significant levels of public involvement. The implications of the requirements include the following:

- **Planning –** Agencies must consider long-term needs, a broader set of issues, and multiple modes in developing their plans, which has greatly expanded the number of investment options that must be considered. In conjunction with the need for plans to be financially realistic, this has exacerbated the complexity and challenge of gaining consensus on a specific set of investment priorities.
- **Programming –** Federal guidelines for STIP/TIP development have helped to make agency programming activities more realistic through the imposition of financial constraint limitations, but they also have increased the scope and challenge of project selection processes. In particular, expanded public involvement requirements have led to increased public awareness of project selection decisions. Federal air quality standards often further add to the complexity of project selection decisions and NEPA requirements have increased the difficulty of accurately estimating project costs and schedules. As a result of these forces agencies are under more pressure to develop accurate STIPs/TIPs and defend the merit of their project selection decisions.
- **Financial Stewardship –** There are a number of new federal requirements under the umbrella of financial stewardship that require states to develop detailed financial plans

for mega-projects and, under SAFETEA-LU, to expand these financial planning techniques to smaller and more diverse projects as well as the program in its entirety. FHWA is taking a much more serious view of the agency's role in reviewing and approving financial plans for major projects before federal funds may be committed

Other Reporting Requirements

Under GASB 34, states must now report the annual condition of their transportation infrastructure. This requirement is focusing additional attention on asset management and agency priority-setting activities. Other state reporting requirements also place greater demands on state DOTs to track and report financial information to a wide audience of elected officials, oversight bodies, and the general public.

Public Role

The public's influence over transportation investment priorities continues to expand. In part, this is due to increased public involvement practices associated with planning and programming, but it also reflects the public's growing understanding and concern about the relationship between transportation and quality of life. While agencies welcome stronger citizen involvement in policy-making processes and investment prioritization decisions, the increased participation is placing added demands on agencies to define responsibilities and boundaries, facilitate public engagement, educate citizens, and develop technical and non-technical mechanisms for communicating the system performance implications and financial realities of alternative approaches.

Improving Technology, Tools, and Data

Expanded collection, accuracy, and usefulness of system performance data and development of improved tools and techniques to support decision-making are enabling states to incorporate a broader range of considerations and analysis into priority-setting activities.

Barriers to Change

Despite the many forces that are driving the need for changes in how priorities are established and how project selection is supported, there also are several factors that create barriers to both changes in existing priorities and the evolution of new priority-setting tools, processes, and policies. Examples of commonly experienced barriers include the following:

- **State Legislation** – State laws often earmark funds for specific projects/programs or mandate planning processes and funding distribution approaches. This can lead to funding allocation practices that do not reflect agency priorities (particularly if the provisions are dated) and may be contrary to both technical findings and public interests.
- **Public Expectations** – Existing plans, programs, and STIP/TIPs often create public and stakeholder expectations that a project or program will be completed, even if higher priorities have since emerged.
- **Project Continuity** – Agencies typically are reluctant to stop or slow down projects once they have begun, even if clearly higher priorities emerge. This is to avoid wasting resources and drawing fire from project advocates, but also tends to be part of an agency's culture – "you finish what you start." This can pose a significant barrier to reprioritization, particularly when large, multi-phase projects are involved that tie up the lion's share of resources for a great number of years.
- **Air Quality Considerations** – In areas in non-attainment, the decision to build or not build a facility may be driven more by a project's anticipated impacts on air quality conformity than on an initiative's consistency with a broad range of agency priorities.

- **Geographic Funding Equity** – While no agency can (or should) ignore funding equity issues, an over-emphasis on "fair share allocations" can limit an agency's ability to address the state's or region's highest priorities at a given point in time.

2.3.2 Obtaining Resources

Similar and in fact overlapping with the key drivers of change for identifying priorities discussed above, the program management functions related to obtaining resources can be characterized by substantial change and heightened challenge. Transportation funding has evolved from a structure that was largely based on pay-as-you-go approaches, with FHWA reimbursing states for 80% to 95% of project costs and functions related to obtaining resources focused on maximizing federal resources and ensuring the limited non-federal share would be made available by state legislatures. There was very limited reach beyond the state for funding and programs were sized to fit the anticipated funding – and timing of funds – of the rather straightforward federal-state funding partnership. This funding paradigm, however, broke down over time as needs began to outstrip available resources and new approaches were deemed necessary. The following is a discussion of the primary forces that have driven change and created the need for alternative approaches and tools for obtaining resources.

Growing Investment Needs

As discussed in the prior section on identifying priorities, the demand for transportation investment is growing at a staggering rate, both in terms of the level of funding needed and the range of investments requiring financial support. Further, the mounting needs are not projected to subside but rather, as system preservation and rehabilitation needs mount alongside demands for new capacity improvements, demands that outstrip available resources have in many respects become the accepted norm. The growing demands have a direct and obvious influence on state DOT practices for obtaining resources. Specifically, state DOTs now routinely carry out the following functions as it relates to seeking resources to meet mounting needs:

- **Investment Studies** – State DOTs now routinely develop investment studies to support their needs assessments, with such studies targeted at policymakers as well as the public at large.
- **Funds Solicitation** – DOTs now seek funding from a wider range of sources, including local financial participation and private equity.
- **Legislative Support –** DOTs work closely with state legislatures and other state agencies, with the focus on identifying candidate alternative funding sources and supporting legislative initiatives to expand the funding pool.
- **Education –** DOT staffs spend considerably more time than in the past educating policymakers and the public, for instance, on the need for additional funding and the potential application of financing approaches (e.g., borrowing in the capital market) to meet growing demands.

Increased Competition for Funding

Coupled with mounting investment needs, states are facing ever-increasing competition for funds. Competition for scarce public resources is growing at all levels of government. At the federal level, rising budget deficits combined with the potential insolvency of the Highway Trust Fund make large future increases in federal transportation funding unlikely and increases competition for earmarks and discretionary grant funding. State budget difficulties have led to cuts in general fund allocations and/or redirecting of motor fuel taxes and vehicle user fees to non-transportation purposes in some states. This increased competition mandates greater rigor in making the case for transportation, relative to other vital state needs, and to looking beyond traditional funding sources to identify

potential supplemental funding. In some states, this has resulted in specific new program management activities, including the following:

- **Education and Outreach –** State DOTs now develop primers and promotional materials (e.g., on the value of transportation investment to the state and its citizens) and often form task forces of state and local leaders to help advocate for transportation investment.
- **Fund Protection –** State DOTs find themselves needing to develop strategies to protect transportation funding from competing demands, such as establishing and securing state-level trust funds, pulling back transportation-related revenues that have been diverted to general funds or other state purposes, and avoiding the accumulation of excess cash balances that can be "raided" to help address other state needs.
- **Instilling Trust** – By demonstrating that transportation resources are being well-spent and managed, state DOTs strive to instill and maintain the trust of policymakers and the general public.

Uncertainty Regarding Long-Term Viability of Fuel Taxes as the Foundation of Transportation Funding

For decades, the building and maintenance of transportation infrastructure has relied primarily on a combination of national and state-level fuel taxes. Nearly 90 percent of federal transportation revenues come from fuel taxes. Such taxes also are a key contributor to state-level transportation funding, accounting for about half of state highway expenditures. Transit capital funding also is dependent on fuel taxes as a recipient of Highway Trust Fund dollars at the federal level and allocated portions of the state and local fuel tax programs of many states.

The future of fuel taxes as a dependable source of transportation funding over the long-term is hotly debated. This debate, however, does not focus on *whether* there will be a decline in fuel tax proceeds but rather on *when* such reduction will occur. As a result, state DOTs are beginning to consider alternative, and more diversified, funding strategies. Related program management activities include the following:

- **Identifying Supplemental Funding –** State DOT financial managers and senior staff spend an increasing amount of time trying to identify candidate funding sources at the state and local level to supplement or replace fuel tax proceeds, such as sales taxes, other general revenue sources, and user fees such as tolls and mileage-based (vehicles mile traveled, or VMT) charges.
- **Supporting User Charge Systems –** A handful of state DOT staffs also are focused on developing strategies to enhance the feasibility and acceptability of user charges, including development of technology to support electronic toll collection and the deployment of VMT charges.
- **Creating Environment for Private Financial Participation –** State DOT staffs in some states are working to create programs to attract and manage private financial participation in transportation system development.

Technological Advancements

There is a direct link between the increasing acceptance of user fee systems – specifically, toll roads, High Occupancy/Toll (HOT) lanes, and VMT charge systems – and the technological advancements that make these charge systems feasible. The extent to which such user charges can be collected seamlessly – without the inconvenience of waits and toll booths, for example – will continue to increase the public's acceptance of this method of obtaining resources for transportation investments.

Expanded Range of Funding Sources

While the broadening of the mix of transportation funding is in and of itself a positive trend, this expansion carries with it new challenges and program management responsibilities. New funding approaches often come with new strings and limitations on their use. For instance, legislatures may provide new funding but mandate its use for particular projects or program areas. Toll revenues (and associated financing mechanisms) can bring limitations on how these revenues may be spent. Additional state and local funding sources with such funding specifically dedicated to a particular mode, program, or individual project can carry a myriad of restrictions and requirements that must be carefully managed. And, finally, the newest and perhaps boldest new source of revenues derived from the sale, or long-term lease, of transportation assets, brings with it a myriad of new policy and financial challenges and issues.

The wider range of funding sources also can introduce new variability in the level and timing of funds availability. Again, this must be carefully evaluated and factored into states' programming and cash management systems. Specific program management activities that relate to this trend toward broader funding include the following:

- **Revenue Forecasting** – State DOTs find themselves faced with the need to develop forecasting techniques for a broader mix of revenues.
- **Programming and Budgeting** – Advances in funding and program delivery are creating the need for programming and budgeting systems that are more sophisticated, requiring development of related decision-support systems.
- **Cashflow Forecasting and Cash Management Systems** – State DOTs now require cashflow forecasting and cash management systems that are equipped to handle greater concerns regarding funds predictability across a wider range of sources.
- **Private Sector Negotiations and Coordination --** In the case of increased private financial participation, state DOT staffs must be able to carry out negotiations and other coordination activities with private financial partners, thus requiring negotiation as well as new analytical skill sets and staff resources.
- **Financial Tracking Systems** – State DOTs require tracking systems that are equipped to keep track of the specific requirements of particular funding sources and ensure appropriate funds management.
- **Communications with Funds Providers** – State DOT managers now spend considerably more time keeping state legislators, local governments, and the public apprised on financial matters, including the use of specific funding and individual project progress and status.

These activities dictate the need for new and expanded skill sets of financial and program managers within state DOTs as well as the tapping of external expertise when needed.

New Financing Approaches / Mechanisms

As noted above, to support increasingly complex funding needs, states are turning with greater regularity to new financing approaches whereby future funding streams are leveraged to meet investment needs sooner than possible under traditional pay-as-you-go approaches. Examples of such alternative financing approaches include:

- **Borrowing Against Future Federal Revenue Streams** – termed grant anticipation borrowing and, even more specifically, Grant Anticipation Revenue Vehicles (GARVEEs);
- **Borrowing Directly from the Federal Government via Available Federal Credit Programs** – e.g., Transportation Infrastructure Finance and Innovation Act (TIFIA) and Railroad Rehabilitation and Improvement Financing (RRIF) programs;
- **Crafting Public-Private Partnerships** – that include private equity or debt financing; and
- **Utilizing Leasing Approaches** – whereby rather than funding the upfront cost of capital facilities, the project sponsor enters into a long-term lease for the asset.

Application of these approaches to leveraging resources both offer opportunities and present challenges. On one hand, mechanisms such as grant anticipation borrowing, federal credit, and private ownership arrangements can help states maintain consistent investment levels during short-term funding dips and/or when faced with an unusually large project relative to the state's overall program. On the other hand, many of the approaches also create long-term financial burdens that will need to be met by future administrations and generations of taxpayers, and that will have a significant bearing on a state's ability to meet new program needs. These approaches also require DOTs to adopt new program management approaches and develop new administrative capabilities. Specific examples of resulting program management functions associated with expanded application of alternative financing approaches include the following:

- **Coordination with Other State Agencies** – State DOT must spend additional time coordinating with other state agencies, such as finance cabinets, treasurers' offices, and debt oversight bodies, regarding debt management and finance policies and practices.
- **Decision Tools –** State DOTs find themselves in need of decision tools to help balance short-term and longer-term financial considerations and to fully understand the ramifications of employing debt to meet funding needs.
- **Project and Program Fiscal Controls** – State DOTs must now strive to create the necessary project and program controls to accommodate market (lender) demands for cost control and project accountability.
- **Reporting –** State DOT financial managers are beginning to spend an increasing amount of their time meeting reporting requirements associated with new financing approaches, including those associated with federal mega-project financial plan requirements, state-level debt oversight bodies, and those of the rating agencies and bondholders.
- **Senior Staff Involvement –** State DOTs that are at the frontier of utilizing alternative funding approaches are increasingly faced with the need to dedicate significant senior staff time to overseeing increasingly complex financial programs and negotiating financial partnerships with private parties. These functions are not readily delegated to more junior staff or outside advisors.

The advent of these new and expanded functions has required states to hire in-house staff with greater finance expertise as well as to forge contractual relationships with outside advisors to secure the necessary market expertise.

Greater Private Sector Role in Program Delivery

Increased reliance on the private sector in delivery of state transportation programs – both in instances where private funding is provided and where other forms of risk-sharing are involved – has imposed

new management requirements and the need for new capabilities for DOT staff. There is a direct interplay with the program management functions associated with obtaining resources in that some of these partnerships with the private sector bring with them demands on the timing of funds availability. Private sector involvement can, for instance, impose greater rigidity in project schedules and constrain the ability to shift resources among projects as fluidly. It also can bring longer-term commitments of financial resources, for instance, with new lease and warranty mechanisms.

Barriers to Change

While the need for some degree of program management changes to meet new demands in the area of obtaining resources is well-documented and accepted, there remain some barriers to changes in program management approaches and in the advent of new tools, processes, and techniques. Examples of commonly experienced barriers include the following:

- **Lack of Political or Public Will** – Proven to be the norm, a lack of will to impose new taxes or provide alternative funding to meet demonstrated needs is a near universal constraint faced by state DOTs.
- **Competition for Funding –** Severe competition for funding at both the state and federal level is both a force of change and a barrier to change.
- **Imbedded Bias Against New Approaches and Debt** – It is not unusual for DOT managers to be faced with internal and/or state legislative bodies' bias against new approaches and/or the use of debt. This can detract from the use of new approaches, including those that require enhanced partnerships with the private sector or increased perceived financial risk.
- **Lack of Staff Resources** – Constrained staff resources and difficulty attracting staff with needed expertise to oversee complex financial programs is a continuing challenge facing state DOTs.

2.3.3 Delivering the Program (Redefining Roles)

As with most government sectors, the transportation industry is experiencing significant organizational change. High attrition rates, decentralization of project development and delivery functions, and outsourcing of everything from administration functions (e.g., IT desks) to full-scale construction program management are just a few of the factors that are influencing DOT program delivery. Following is a discussion of the primary forces that have driven change and created the need for alternative approaches and tools in program delivery. As noted in the introduction, while the title of this category is quite broad, this study focuses on program management elements related to the choice between in-house delivery and outsourcing and the distribution of management responsibilities among in-house personnel (both headquarters and district-level) and private sector partners.

Program Expansion

Many state DOTs have experienced significant growth in the size of their programs, requiring them to deliver more projects in a given time period. This expansion is taxing the resources of the DOTs, both in terms of the number and capabilities of existing internal staff.

Increasing Project Complexity

State DOTs are experiencing increasing complexity of transportation projects, including mega-projects, multi-modal projects, and projects that must take into account existing infrastructure and development. The increased project complexity is forcing DOTs to perform a broader range of activities, which in turn is leading to the development of in-house capabilities or access to outside sources for new skill sets. In addition, the need for better coordination of various project development

and construction activities, such as NEPA documentation, design, right of way acquisition, utility relocation, letting, and construction, is driving DOTs to experiment with new organizational structures (e.g., the choice of centralized versus decentralized approaches) and alternative project management approaches (e.g., "cradle-to-grave" vs. traditional "silo" management approaches). The size and complexity of projects also is leading some DOTs to explore alternatives for risk management and risk sharing.

Changing Management Focus

Traditionally, DOTs have generally been known for being engineer-dominated organizations, with engineers in most key positions – from the Secretary or Executive Director on down – even in planning and financial management positions in many organizations. This situation, however, is beginning to change as states reach out for other disciplines, including business management, environmental planning, and finance. Some state DOTs are moving from a focus on the best engineering solution, barring all other considerations, to the best business solution, factoring in a wider range of considerations such as cost and the context of the physical environment. As DOTs also move from organizations of doers (e.g., design) to organizations of reviewers and overseers (e.g., contractor oversight and management), the staffing needs of the organization changes and, with a new staffing mix, so do the management styles and focus. The shift in management focus has ramifications for nearly all aspects of program management and must be factored into the development of new tools, techniques, and processes.

State DOT Workforce Issues

A number of trends are limiting the ability of state DOTs to adequately deliver programs with internal workforces, including state-imposed restrictions on hiring. Most state DOTs also are experiencing high levels of attrition due to retiring personnel, who are not being replaced in equal numbers. At the same time, younger employees are less likely to spend their entire careers with an agency. This is forcing state DOTs to do more with less and rely on staff with decreasing experience levels.

New Private Sector Capabilities

Private sector firms have established new capabilities to manage the delivery of transportation projects. They have achieved this by transferring expertise from other infrastructure sectors (e.g., water and energy) and by developing design-build and other comprehensive project delivery approaches. The increased capacity of the private sector to manage transportation projects and programs is enabling state DOTS to consider outsourcing in new areas and leading privatization advocates to pressure agencies to outsource more activities.

Downsizing / Outsourcing of Project Delivery and Program Management Functions

DOTs are faced with the need to downsize – and, in some instances, outsource – more of their project delivery and program management functions. This is the result of a number of influences, including: 1) lack of available personnel with the appropriate skills and training; 2) need for different skill sets than currently exist with current in-house staff; 3) flexibility associated with outsourcing with respect to pay levels, number of staff, and other elements; 4) uneven needs that support outsourcing rather than staffing up internally; 5) hiring freezes and related pressure from state governments for staff reductions; and 6) in some instances, a perception that outsourcing is simply "better" or "the right thing to be doing."

As state DOTs have been driven to downsize their internal staffs and also have recognized that it is not always feasible to maintain in-house expertise to meet the expanding technical needs or workload spikes, they find themselves relying more heavily on private firms for both individual project delivery

and overall program management functions. This trend has significant bearing on in-house management functions. Examples of such ramifications include the following:

- **Decision-making Frameworks** – State DOTs find themselves in need of new and enhanced decision-making frameworks to help choose between in-house and outsourced management.
- **Information Management Systems** – State DOTs are confronted by the need for new and updated information management systems that can be accessible to and shared with outside vendors as needed and vice versa.
- **Procurement, Contracting, and Consultant Oversight Mechanisms** – State DOTs require new procurement, contracting, and oversight mechanisms that are designed to facilitate routine outsourcing not only for traditional design, engineering, and construction contracts but also for more administrative and management functions traditionally performed by in-house personnel.
- **Training** – To keep up with changing program delivery approaches, state DOTs require new types of training for in-house staff as well as for outside vendors on managing the work program via partnership arrangements.
- **In-house Capability** – Despite the outsourcing of a variety of program management functions, state DOTs recognize the need to maintain at least a minimal level of in-house capacity to perform oversight and as a backstop to ensure program continuity.

Barriers to Change

While many of the trends or influences affecting delivery of transportation programs and the mix of players involved represent opportunities, they are sometimes met with opposition or limited by barriers. Examples of potential barriers to change in the area of program delivery include the following:

- **Organizational Culture** – While much change has taken place in state DOTs, resistance to change and to giving up the old and comfortable ways persists in some organizations.
- **State Procurement and Labor Regulations** – As noted, the ability to easily procure the necessary services and to break the procurement mold is critical to the ability to deliver ever-growing transportation programs with shrinking in-house staff.
- **Federal Restrictions** – While many federal restrictions have been lifted or eased, there remain many limitations on states' ability to carry out program delivery in new and innovative ways.
- **Stakeholder Concerns** – While there is pressure from some avenues to change internal management approaches and to rely more heavily on the private sector, there also is resistance from project stakeholders regarding the shifting of management responsibilities to private firms.
- **Industry Resistance –** Private firms that have grown accustomed to the comfortable relationship and norms of traditional project management approaches may resist change, including the change required of their own organizations to accommodate new management approaches.

2.3.4 Managing Finances

Several factors are converging to radically increase the complexity of state DOT financial management functions. To begin with, states now manage more projects – and a greater variety of projects – than every before. This includes multi-modal projects that rely on a combination of disciplines and funding. Second, projects have become more complex, with long project development periods, frequent cost and schedule revisions, and complex project phasing – all of which need to be carefully managed. Third, contractors, stakeholders, and the public have heightened expectations about information availability and administrative turnaround times. Finally, the mix of state and federal project funding, use of alternative financing approaches, and new project delivery options create new financial management and documentation demands. In essence, the forces identified in the three prior areas – Identifying Priorities, Obtaining Resources, and Delivering the Program – are, for the most part, the forces that influence and create demands in the financial management arena. These forces are described further below.

Changing Project Delivery Paradigms (Impact on Cash Management)

Program management activities focused on expediting project delivery have a direct bearing on the cash management requirements of state DOTs. States that have successfully addressed bottlenecks in project delivery through environmental streamlining and other approaches often find themselves with new challenges in the area of cash management – moving from the problem of excess cash on hand to the potential problem of overspending available resources. Improved project delivery thus mandates more careful cash management and more sophisticated planning and tracking tools.

New Funding Paradigms (Impact on Budgeting and Cash Management)

The advent of new funding approaches and, in some instances, greater flexibility at the federal and state level has created new demands on the budgeting and cash management functions of state DOTs. Increased use of Advance Construction and related tools associated with managing the federal program have provided opportunities for more efficient use of funding by state DOTs but also have created new demands on the cash management function. Similarly, the forecasting needs associated with a broader set of funding streams and the complexities of integrating debt financing efficiently into program management have spurred advancements in cash management among the leading DOTs, with new tools being developed as new needs arise. Finally, as the mix of federal and state funding shifts, changes to the financial management requirements also develop, including the need for more robust budgeting techniques, tracking of funding-related requirements and compliance, and efforts to minimize the impact of such requirements through careful matching of dollars to individual projects.

Funding and Program Delivery (Impact on Debt Management)

Similar to the impact of improved project delivery on cash management within state DOTs, expanded funding programs and improved program delivery can have a direct impact on states' debt management practices and policies. As the mix of funding expands, opportunities to utilize both short- and long-term debt financing to match resources with project and program needs also grow in scope and complexity. Debt programs are no longer based strictly on future state fuel tax revenues but can include a combination of federal, state, and even local funding streams and go beyond the relatively straightforward fuel tax to include a myriad of additional revenue streams. Such new financing structures require new policies and practices be developed to properly manage the state's debt profile. Many states find themselves struggling with the question of what is the "right" level of debt and for which projects is it appropriate to enter into these long-term financing commitments.

New Finance Approaches (Impact on Financial Reporting Requirements)

Many of the new funding and finance approaches also carry with them new reporting requirements, including those stemming from new federal and state legislative requirements and from providers of

outside capital and their surrogates (e.g., rating agencies). States thus must develop new and adjust existing tracking and reporting mechanisms to fulfill the requirements of a variety of information consumers.

New Federal Oversight of Financial Stewardship (Impact on Reporting Requirements)

Several factors are increasing federal interest in oversight of state DOT financial management activities. In particular, large cost overruns on mega-projects like the Boston Central Artery project have led the federal government to increase financial management and reporting requirements. Other considerations, such as broadening use of federal innovative fund management techniques also are leading the government to pay greater attention to how states are managing federal transportation dollars.

New Priority-Setting and Asset Management Approaches (Impact on Reporting Requirements)

Requirements associated with GASB 34 compliance and legislative and public accountability expectations are creating the need for more robust financial data, including as it relates to project delivery and cost estimating. Contractors, stakeholders, and the public also have heightened expectations about financial information availability and administrative turnaround times.

Barriers to Change

As with the prior program management areas, even when new program management demands can be identified, they cannot always be easily satisfied. Several specific barriers to change in this area include the following:

- **Staff Expertise Limitations** – State DOTs face challenges attracting and retaining staff with the necessary expertise.
- **Technology Barriers** – While state DOTs are beginning to invest significant resources in financial, project, and program management systems, these systems take a long time to be brought fully online and their capabilities fully utilized for program management.
- **Organizational Resistance** – DOTs often fall victim to the "we've always done it that way" syndrome and thus some of the new financial management regimen called for today is difficult to effectively implement.
- **State and Federal Legislative Barriers –** There are a number of legislative barriers to new financial management approaches, including restrictions on both short- and long-term borrowing that require legislative and, in some instances, constitutional changes.
- **Public Perception Issues** – As financial managers strive to manage the overall finances of the transportation program, they also must confront public perception issues associated with individual project delivery and costs. For instance, a decision to finance a particular project with debt will increase the cost of that project but, at the same time, free up pay-as-you-go resources for other projects, potentially saving money by expediting those other projects. The public, however, will focus on the increasing cost of the one, often high-profile, project and have difficulty understanding the nuance of the combined financial benefit to the program.

2.4 SUMMARY – COMBINED IMPACTS OF FORCES OF CHANGE

While many of the forces of change reviewed in the previous section have significant implications even when they operate independently, it is the combined effect of these forces that is driving fundamental change in program management and delivery of state transportation programs. These forces combine to create both positive results and new challenges.

The positive combined impacts of the program management influences that are the focus of this study include:

- Improved multi-modal system planning;
- Optimization of investment decisions;
- The advent of more efficient – and effective – organizations;
- Improved project and program delivery performance;
- Broader participation in funding for transportation – and more avenues to tap into those sources; and
- Greater accountability, leading generally to broader public support.

While there are important positive effects of the mix of forces on program management, these forces also work together to create new challenges and program management demands.

These positive outcomes and new challenges are the subject of the following chapter which focuses on the state of the practice in program delivery management and identifies areas of continued weakness or gaps in the tools, techniques, management processes, and knowledge necessary to carry out effective program management under current fiscally-constrained conditions.

3. STATE OF THE PRACTICE: TOOLS, TECHNIQUES, AND MANAGEMENT PROCESSES FOR EFFECTIVE PROGRAM DELIVERY

3.1 INTRODUCTION

This chapter draws on the lessons of the prior chapter regarding the collective impacts of the forces of change on program management to focus on the state of the practice in key program management disciplines and to identify critical gaps in practice that could be the focus of future efforts. The discussion is organized, once again, around the four functional areas: 1) Identifying Priorities; 2) Obtaining Resources; 3) Delivering the Program; and 4) Managing Finances. Following a discussion of the state of the practice and associated gaps for each of the four program management areas, the chapter concludes with a table that summarizes the identified state DOT needs for tools, techniques, processes, and knowledge based on the research. In addition to detailed descriptions of identified needs, the table provides a discussion of research considerations associated with each need, recommends whether further research should be considered and, where research is warranted, identifies potential case study candidates.

3.2 IDENTIFYING PRIORITIES

State DOT priority-setting practices continue to evolve and are becoming more transparent, participatory, interrelated, and complex. Past state DOT prioritization efforts such as strategic plans, statewide plans, system plans, and programs of projects often were conducted in isolation from one another, internally driven, mode-centric, and focused on defining desired projects. Today, agencies are more focused on establishing strategic frameworks and multimodal decision-making processes than on producing physical plans, and prioritization activities have shifted from identifying desired outputs (e.g., lists of projects) to defining desired outcomes (i.e., system performance targets). To accomplish this, agencies are both working to improve the linkages between prioritization activities and employing a range of tools and techniques to support improved decision-making.

3.2.1 Tools, Techniques, and Management Processes for Identifying Priorities

The following is a brief list of tools, techniques, and processes state DOTs are currently using to identify priorities:

- **Needs Analysis** – Almost all states use long-range planning to identify both short- and long-term investment needs, but agencies express their needs in a variety of ways. Most states separate needs by mode or corridor, often subcategorized by expansion, modernization, and preservation needs. Alternatively, some states split needs between capital and operating requirements, or define needs in terms of freight movement, economic development, mega-projects, and other special categories. Several states have begun to use tools to quantify long-term highway investment needs, such as FHWA's Highway Performance Monitoring System (HPMS) and State-level Highway Economic Requirements System for (HERS-ST), while

approaches to identifying needs for other modes tend to be qualitative and vary widely from state to state.

- **Strategic Frameworks** – Agencies vary in the types of vision, goals, and objectives they set for themselves and their transportation systems in strategic plans, long-range plans, or other priority-setting documents. Common goal categories include: safety, system preservation, mobility and accessibility, connectivity, operations and maintenance, freight and economic development, administrative effectiveness, environmental stewardship, and finance. State DOTs also differ in how they apply their strategic frameworks – some focus on the overall transportation system, while others focus more on individual modes and/or corridors.
- **Performance Measures** – The use of performance measures within DOTs clearly is growing and measures are widely viewed as a tool to help agencies use their limited resources more effectively. All states have and use at least some performance measures (e.g., bridge and pavement preservation measures), and many states have developed expanded performance measurement systems to cover all or most of their key functions and goal areas. Several states are using (or plan to use) measures as a means to link strategic plans and/or statewide long-range plans to programming activities, and as a means for communicating agency priorities to stakeholders. The linkages and coordination between performance measurement and other activities such as statewide planning and asset management vary from state to state, but there appears to be a fair amount of overlap and redundancy.
- **Asset Management** – Recent studies identify that asset management is emerging as an important business process to help transportation agencies assess the tradeoffs between investment options and make cost-effective program- and project-level decisions. In some areas, such as system preservation, safety, and maintenance, the use of asset management-type systems and approaches (e.g., life cycle cost and benefit/cost analysis) is widespread. While several states are working to develop asset management approaches to assess a broader range of scenarios (e.g., investment tradeoffs across different types of highway investments, system tiers, or modes), the current state of the practice is largely to use asset management as a means for prioritizing projects within a specific program category (e.g., ranking congestion relief or system preservation projects).
- **Financial Analysis** – The level of fiscal constraint state DOTs impose on their priority-setting activities varies based on the type of activity (federal law requires that only STIPs and TIPs be fiscally-constrained) and a state's individual approach. Some states simply assume "flat line" estimates of future funding or develop estimates without significant external input. Other states, such as Florida and Pennsylvania, conduct regular workshops with stakeholders to discuss and/or develop revenue estimates. In general, the best approaches appear to incorporate a big picture perspective of finance that includes needs/costs estimating, economics and demographic analysis, revenue forecasts, gap analysis, cost and revenue sensitivity analysis, and identification of options for addressing shortfalls.
- **Public and Stakeholder Involvement** – States use a variety of mechanisms to conduct public and stakeholder involvement. The most commonly used approaches are public meetings, surveys, workshops, mailings, and indirect outreach through MPOs. To reach stakeholders, many states work through their MPOs, and several states have set up regional planning bodies or advisory bodies. States vary with respect to the timing of their outreach efforts (prior, during, or after plan development), but many conduct outreach at multiple times throughout their planning and programming processes.
- **Programming** – Most states intentionally over-program by 5% to 15% to provide flexibility if project schedules slip. State programming documents generally vary in length from three

to six years. Several states such as Texas and New Hampshire develop mid-range programs of projects that cover a span of six to 12 years.

3.2.2 Gaps in Tools, Techniques, and Processes for Identifying Priorities

While significant advances have occurred in recent years, there are a number of critical gaps or weaknesses in tools, techniques, and processes for identifying priorities. The following is a list of the identified gaps in practice where additional research, improved tools, and policy guidance could benefit state DOT priority identification:

- **Needs Analysis** – Better data and analytical methods are needed for quantifying project/program economic benefits, estimating/verifying local needs, identifying freight needs, and assessing the impacts of technology and demographic changes on transportation demand. For example, improvements to the HERS-ST model are needed to enable analysis of more sophisticated performance data.
- **Quantification of Benefits** – Enhanced data and analytical methods are needed for quantifying project/program economic benefits and analyzing the relationship between investment and performance in areas such as safety, preventive maintenance, and congestion relief.
- **Planning Scope** – Agencies could benefit from development of approaches for integrating a broader set of considerations into needs identification and priority-setting processes, such as local and regional planning implications, environmental issues, land-use/transportation coordination, and maintenance/operations needs.
- **Performance Measures** – Better performance measures are needed in a number of areas to assess relative agency performance for responsibilities with system partners, environmental stewardship, operations/ITS, reliability, and system-level performance.
- **Asset Management/Tradeoff Analysis** – Creation, expansion, and improvement of asset management tools is needed to provide more robust tradeoff analysis capabilities across different types of investments (e.g., system preservation vs. expansion), different modes, and multiple objectives for alternative programs of projects. Asset management systems tend to exist independently for different DOT functions and mechanisms and frameworks are needed for tying them together. Also, standardization of asset inventory and condition/performance data is needed.
- **Cost Estimating** – Improved approaches are needed for scoping and estimating project costs early in the project development process and to support formulation of appropriate contingencies for future project development.
- **Planning Practices** – Documentation is needed on how states are using fiscal constraint in long-range planning and on statewide policies and processes related to the geographic distribution of funds.
- **Public/Stakeholder Involvement** – Agencies need guidance on how to keep the public and industry involved and engaged throughout entire planning and priority-setting processes (not just at the front or back end).

3.3 OBTAINING RESOURCES

State DOTs are evolving from relying exclusively on federally-based, mode-centric, pay-as-you-go approaches to transportation investment and developing a range of new funding, financing, and public-private partnership tools. The current focus is on how to best apply these new approaches and extend their use to more than a handful of special projects and programs.

3.3.1 Tools, Techniques, and Management Processes for Obtaining Resources

The following is brief list of tools, techniques, and processes state DOTs are currently using to obtain resources for transportation investment:

- **Federal Funding** – Federal transportation apportionments, earmarks, and discretionary funding remain key funding sources for state DOTs. For most states, using all available obligation authority is a primary objective to avoid giving back money (i.e., obligation authority) in the August redistribution. Agencies also have limited access to resources from other federal agencies, such as funding from the National Forest Service and the Bureau of Land Management to help pay for facilities that support federal lands.
- **Federal Credit** – Section 129 (of Title 23) and creation of the TIFIA program is leading a handful of states to use federal credit in the form of federal loans, letters of credit, and loan guarantees. Largely by program design, the use of TIFIA assistance has been limited to large highway and transit projects.
- **Leveraging Federal Funds –** While state DOTs have a long history of using federal funds to repay the principal portions of project debt, changes in federal law in the NHS Act expanded the financing costs that can be repaid with future federal revenue streams. As a result, a number of DOTs are now issuing direct and/or indirect GARVEEs to finance projects and programs. An FHWA Innovative Finance Newsletter (Fall 2005) notes that 28 GARVEE bond issues have been placed for a cumulative total of $5.1 billion. These include only direct GARVEEs – those tracked by FHWA.
- **State Funding** – All state DOTs fund a large portion of their programs through state-raised revenues. In fact, for many states, the share of program costs that are funded by state revenues is growing. For most states, the primary sources of state transportation funding are fuel taxes revenues, vehicle user fees (licenses, registrations, etc.), and transportation-related sales taxes. Some states allocate general fund revenues to transportation, although state budget deficits in recent years have led to a reversal of this practice.
- **State Debt** – State DOTs vary widely in their use of debt. Several states have a long history of borrowing against state revenue sources to meet federal matching requirements and/or pay for the non-federal portions of their transportation programs. Several states are nearing the end of special debt programs that designated specific revenue streams to finance programs of projects. Some states are utilizing debt for the first time.
- **Tolling** – Tolling and the use of toll-revenue financing continues to have isolated application across the country, although several state DOTs have begun to consider broader use of toll roads, enacted enabling legislation, or initiated projects. A few states have started to implement value pricing and HOT lanes as a way to both raise revenues and manage demand/congestion. A number of states have identified that any new major

capacity projects will be at least partially toll-financed. A few states, particularly those with older toll facilities, use toll revenues to fund a portion of their state program.

- **Public-Private Partnerships** – More than ever before, states DOTs are working with the private sector to obtain resources and deliver projects and programs. Private support for projects can range from in-kind contributions of right-of-way and materials, to private financing, to concessions where private companies finance, operate, and purchase or enter into long-term leases for facilities. States also are finding new ways to raise money or gain in-kind benefits from private partners through the lease, sale, or barter of agency facilities, equipment and air space for a host of activities including advertising (e.g., naming rights) and placement of telecommunications fiber and cell towers.
- **Local Funding** – Many state DOTs are working in close partnership with local governments to help fund both state and local transportation investment. Several states encourage local governments to contribute to project costs to accelerate project completion. A handful of states are using their state infrastructure banks as a way to facilitate these local contributions.

3.3.2 Gaps in Tools, Techniques, and Processes for Obtaining Resources

There are a number of critical gaps or weaknesses in tools, techniques, and processes for obtaining resources. The following is a list of the key areas where improvements would benefit state DOTs in obtaining resources:

- **Administrative Expertise** – State DOT personnel often lack the education, training, and experience needed to successfully develop and implement alternative funding and financing approaches. Research is needed to document new requirements and suggest strategies for addressing them.
- **Monitoring Capabilities** – State DOTs need new analytical capabilities and information to predict, monitor, and adjust for the long-term impacts of new financial tools, such as GARVEEs, TIFIA loans, and SIBs. For example, agencies will need assistance determining what level of borrowing is acceptable given the size and unique characteristics of their programs, funding structure, and needs.
- **Development of Public-Private Partnership Policies** – New relationships between DOTs and private sector partners are creating the need for changes in state laws, regulations, and policies. Research is needed to support these changes, such as information and guidance on appropriate roles and risk-sharing approaches among public and private partners.
- **Policy and Planning Integration –** Current state planning, programming, and project development activities such as NEPA processes and STIP development are not well suited to handle some of the new funding and financing approaches. Agencies need help in determining how to change business processes and policies while still meeting various state and federal requirements.
- **Improved Benefit Analysis Tools** – Better and broader approaches to quantifying project and program benefits are needed to both support and help justify new funding and financing approaches.
- **Implications of New Revenue Mechanisms** – Agencies would benefit from a better understanding of the social and distributional implications of alternative funding approaches for transportation.

- **Rehabilitation and Preservation Finance** – The primary focus of new approaches to obtaining resources has been for new construction or expansion of existing facilities. Greater research and analysis is needed to determine how many of these mechanisms could be applied to other state DOT functions, such as system preservation activities.
- **Replacing Fuel Taxes** – Due to the long-term limitations of the current fuel tax as the primary funding mechanisms for transportation, broader research is needed on alternatives (e.g., fuel tax indexing and VMT charges).
- **Freight Finance Needs** – Expanded funding and finance tools are needed to better understand and address freight infrastructure investment needs.
- **Multimodal Funding** – Research is needed to support multimodal funding initiatives and identify techniques for eliminating funding silos and other barriers to greater funding flexibility across modes.
- **Information Sharing** – Greater opportunities are needed for transportation agencies to meet and share information with non-transportation public infrastructure officials regarding alternative methods to access revenue and raise capital.
- **Value Capture Approaches** – Research is needed on how agencies can raise revenues by capturing the value of new and existing facilities (e.g., through tax increment financing and development and potential sale of state-owned property).

3.4 DELIVERING THE PROGRAM

State DOTs are in a period of great transition in the roles they perform to deliver programs – shifting from designing and managing projects to managing programs where the private sector is responsible for growing portions of project delivery and program management.

3.4.1 Tools, Techniques, and Management Processes for Program Delivery

The following is brief list of tools, techniques, processes, and activities state DOTs are utilizing to redefine how they deliver their programs:

- **Outsourcing** – A few states, such as South Carolina and Louisiana, have outsourced extensive responsibility for the delivery of major programs. Other states, such as Utah and Maryland, are taking a controlled and incremental approach to delegating broader project and program management responsibility to the private sector, such as experimenting with design-build approaches or using general engineering consultants (GECs) to manage selected programs of projects. A few states, such as Florida, Virginia, and DC, are outsourcing maintenance programs and using asset management-based measures to monitor contractor performance.

- **Alternative Procurement Methods** – Many states have begun to experiment with a variety of alternatives to traditional design-bid-build procurement approaches that require greater cooperation, partnership, and risk sharing between agencies and private sector companies or consortia. The most commonly used approach is design-build, particularly for the delivery of large, complex projects, but this still represents a small percentage (5-10%) of total construction projects. Other approaches include warranties, various

contract incentive/disincentive strategies, allowing unsolicited proposals, design-build-operate/maintain (DBOM/DBM), and granting for-profit concessions.

- **Organizational Approaches** – States are using a variety of organizational options to address special projects and programs (e.g., new toll road programs). Some states, such as North Carolina and Texas, have created toll authorities that are located within the DOT but operate at least somewhat autonomously, while other states have created independent entities.

- **Centralization vs. Decentralization –** Many DOTs have begun to decentralize project development responsibilities. The range of decentralization ranges from minor adjustments, such as moving environmental staff into district offices, to full scale decentralization where nearly all project development resources are located in the field. A handful of states have centralized some of their key support functions.

- **Project Management –** Many state DOTs have limited consistency in project management practices within their own department. Several departments acknowledge that project budgets and scopes are not actively managed, and project managers are not held accountable for scope, budget, and schedule performance. A number of state DOTs have reviewed their business processes for managing and delivering projects over the last few years. Some agencies have moved toward "cradle-to-grave" management of projects. Other agencies have developed team approaches to manage the preconstruction phase of projects.

- **Letting Programs** – State DOT letting program practices tend to be poorly documented, driven by financial (i.e., cash flow) concerns, and lack formalized and structured approaches.

- **Program and Project Management Systems –** State DOTs use a combination of off-the-shelf and custom software to support project and program management. While most states have moved toward utilizing adequate construction management systems, tools to help track and manage pre-construction activities are often lacking. Few, if any, states have successfully tied their management systems together for overall delivery of projects and programs.

3.4.2 Gaps in Tools, Techniques, and Processes for Program Delivery

There are several identifiable gaps or weaknesses in tools, techniques, processes, and approaches that are limiting the ability of state DOTs to redefine their roles to improve program delivery. These include:

- **Staff Capabilities** – State DOTs need a better understanding of the different skills and training needed to oversee new project and program management and alternative procurement approaches.
- **Alternative Procurement Assessment** – Agencies need quantified analyses of the true benefits and costs of design-build and other innovative procurement strategies versus the costs and benefits of traditional design-bid-build approaches. Similarly, agencies need policies and processes to help them determine whether or not an activity should be outsourced.

- **Performance Monitoring Tools** – State's lack adequate tools and mechanisms to assess and document the performance of outsourcing in new areas, such as construction management and maintenance programs.
- **Cultural Barriers** – Successfully redefining DOT program delivery roles will require agencies to overcome significant cultural resistance. To help DOTs foster a project management culture, research is needed to help states understand and combat this resistance.
- **Institutional Hurdles –** Many states lack statutory authority to use alternative procurement approaches, encounter resistance from stakeholder groups and employees, or run up against other institutional barriers. Research is needed to help agencies understand and address these hurdles.
- **Cost and Schedule Tracking Needs** – Better tools, policies and processes are needed to track project and program budgets and schedules, and to monitor the relationships between original cost estimates, programmed amounts, and actual costs.
- **Letting Programs** – Improved tools and techniques that support letting program management are needed. Agencies also need improved mechanisms for data sharing about large projects and their potential implications for costs.

3.5 MANAGING FINANCES

Since there is limited focused literature on state DOT financial management, the current state of the practice in this area is poorly documented. In general, state DOT financial management is in transition – changing from a focus on implementing federally-driven, pay-as-you-go programs to accommodating a much broader range of financial management needs.

3.5.1 Tools, Techniques, and Management Processes for Managing Finances

The following is a brief description of current state DOT practices with respect to financial management:

- **Cash Management** – State DOTs vary in their cash management practices and policies. Most states conduct some form of modeling to project available cash, and then adjust letting schedules to match availability (as opposed to managing cash to meet a desired letting schedule). The sophistication of these models and processes, and the degree to which they are tied to other agency management systems varies from state to state. A handful of states, including North Carolina, Virginia, and Florida, have undergone comprehensive reviews and/or revisions in their cash management practices to find ways to avoid having cash balances that are either too small or too large. Only a few states appear to use or are authorized to use short-term borrowing to provide greater cash management flexibility.
- **Debt Management** – Agency debt programs differ widely from one state to another. To begin with, some departments manage their own debt while others (due to either statute or policy) go through their state treasurer or other centralized agencies to issue debt. States also vary in how they use debt – some agencies finance a large portion of their non-federal spending, while others only use debt on a project-specific basis. Debt levels and annual financing costs (e.g., as a percentage of total program) vary widely from state

to state and there is no consensus on what are appropriate debt levels, or even on how agencies should determine how much to borrow. State DOTs appear to rely heavily on outside experts (e.g., financial advisory firms and other financial consultants) to assist them with their debt programs, although a few agencies have begun to hire in-house financial experts.

- **GARVEE Programs** – Several states (at least 10) now manage active GARVEE Bond programs.
- **Innovative Management of Federal Funds** – While nearly all state DOTs make use of Advance Construction and related tools, some agencies use the mechanisms widely and as often as possible, while others do so on a much more targeted and selective basis (e.g., only for specific projects and/or only on a short-term basis).
- **Financial Systems, Tracking, and Reporting** – Although several state DOTs have recently upgraded or replaced their financial management systems, agency financial tracking capabilities generally are limited (e.g., few if any states have financial systems and project management systems linked to provide centralized, real-time data on project and program financial status). A few states are working to improve the links between their financial management systems and performance measurement activities.
- **Budgeting Links** – The linkage between state DOT financial management and budget activities appears to be limited. In many cases, the allocation of resources to specific programs and activities is driven by state statute or agency decision-making processes that occur externally to the financial management arena.

3.5.2 Gaps in Tools, Techniques, and Processes for Managing Finances

There are a number of critical gaps or weaknesses in tools, techniques, and approaches for financial management that have arisen from the advent of more complex funding programs. These include the following:

- **Expertise and Staff Resources** – State DOT staff generally lack the training, experience, and expertise with new debt and cash management activities and requirements. Agencies need assistance to better understand these needs and determine how to meet them through hiring, training, and outsourcing.
- **Management System Limitations** – State DOT financial management systems typically are ill-suited to meet many of the new financial tracking and reporting requirements. Agencies need help in defining new system requirements, managing system upgrades and replacement, and using the new systems.
- **Debt Management Strategies** – Agencies lack information to help them address key debt management questions, such as what is an appropriate level of debt or how debt programs should be structured.
- **Cash Management Tools** – Many DOTs lack sophisticated models and tools to accurately estimate future cash flow needs and effectively manage department cash balances. Guidance is needed on how agencies can develop and apply more robust cash flow models and other cash management tools.
- **Organizational Barriers** – New cash management requirements are changing the way DOTs do business. Agencies need help to understand and address the organizational implications of these changes.

3.6 SUMMARY

Drawing on the forces of change identified in Chapter 2 of this report, this chapter has provided an overview of the state of the practice across the four broad program management functional areas and identified areas of weakness or gaps in practice across at least a major portion of state DOTs. Based on this review, the table that follows provides a summary of the identified needs, reviews information on recent or ongoing research or other relevant activities related to each identified need, and offers preliminary recommendations regarding which program delivery management needs would benefit most from further research and guidance development.

The table is organized along the four original program management functional areas along with an additional category for cross-cutting topics, as follows: 1) Cross-cutting Topics; 2) Identifying Priorities; 3) Obtaining Resources; 4) Delivering the Program; and 5) Managing Finances.

Activities and Associated Needs	Research Considerations	Potential Research
Cross-Cutting Topics		
Institutional Capacity ▪ Identification of financial education, training, and experience requirements to meet new state DOT roles in the following areas: tradeoff analysis, financial analysis, public-private partnership development and implementation, debt management, and cash management.	Changes in the way state DOTs are funding, financing, and managing their projects and programs are creating the need for new state DOT staff capabilities. Little or no research has been done to define these new requirements and recommend strategies to meet them.	Conduct notable practice/lessons learned research on agencies that have developed strong in-house capabilities and/or have had success with outsourcing to meet new staff resource needs. Case Study Candidates: Colorado DOT, Virginia DOT, Florida DOT
Public/Stakeholder Involvement ▪ Tools, techniques, and processes for educating and interacting with the public and stakeholders on 1) program-level funding, finance, and fiscal constraint; and 2) project-level financial considerations. ▪ Research on the roles of public / stakeholder involvement in obtaining resources, and identification of successful practices for facilitating these roles.	Significant research and development has been conducted on tools and techniques for general public and stakeholder involvement, but there is limited information available on how transportation agencies should talk to and work with the public and stakeholders about complex financial issues.	Conduct notable practices/lessons learned research on public/ stakeholder involvement practices related to financial issues. Case Study Candidates: Michigan DOT, Florida DOT
Strategic Coordination ▪ Guidance on how agencies can better align strategic plans, long-range plans, asset management, business plans, programming, financial management, and project/program delivery.	The active NCHRP project entitled *Factors that Support the Planning-Programming Linkage (*8-50) should partially address this gap, but will not cover the full range of agency strategic activities, such as strategic plans and business plans.	Conduct notable practices/lessons learned research on agencies that have tried to align some or all of their program delivery identification activities. Case Study Candidates: TBD

Activities and Associated Needs	Research Considerations	Potential Research
Performance Measurement ▪ Development of new or improved measures in areas such as freight, environmental stewardship, operations/ITS, reliability, program delivery and finance efficiency.	Various aspects of performance measurement are being studied in probably a dozen separate ongoing or recently completed NCHRP/TCRP projects, but it does not appear that any are addressing performance measures for monitoring delivery of a program of projects (i.e., budget and schedule performance) or for measuring the cost-effectiveness of finance approaches. These topics will be addressed elsewhere in this study and do not lend themselves to stand-alone consideration.	No additional research recommended (addressed elsewhere rather than as a stand-alone topic).
Asset Management ▪ Tools for evaluating tradeoffs in investment levels across functions and modes. ▪ Tools for comparing the benefits of different programs of projects. ▪ Techniques, processes, and tools to integrate asset management with other priority setting activities.	The Phase I reports from the NCHRP project entitled *Asset Management Guidance for Transportation Agencies (20-24(11))* identifies a broad research agenda for asset management that is being addressed by FHWA, AASHTO, state DOTs, and other NCHRP initiatives. What is lacking is research on how to coordinate asset management and other performance measurement/priority-setting activities to avoid redundancy and achieve consistency. This element is addressed under other research topics (e.g., Strategic Coordination) and does not necessitate stand-alone consideration.	No additional research recommended (addressed elsewhere rather than as a stand-alone topic).
Information Management System Integration ▪ Guidance on system requirements and upgrade procedures for meeting financial tracking and reporting requirements resulting from new funding, finance, and project/program management approaches.	Several state DOTs recently have upgraded their financial systems and/or improved the integration of their management systems. The results and lessons from these efforts with respect to project and program finance have not been well-documented in existing research. It is expected that research on management system issues related to project and program delivery will be addressed in the upcoming NCHRP study entitled *Guidance for Transportation Project Management (Project 20-69).* The area of information management systems is also a major topic unto itself and thus beyond the scope of this study.	No additional research recommended.
Cost Estimating ▪ Methods for incorporating risk and contingencies into project and program cost estimating activities. ▪ Guidance for creating system capabilities to track project and program cost estimating histories.	An ongoing project, *NCHRP Project 8-49: Procedures for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction* is due to be completed in February 2006 and is expected to address the identified gaps in DOT cost-estimating practices.	No additional research recommended.

Activities and Associated Needs	Research Considerations	Potential Research
Identifying Priorities		
Programming, Budgeting, and Prioritization ▪ Tools and mechanisms for improved programming. ▪ Documentation of approaches for budgeting (i.e., allocating funds) by program, mode, and/or region. ▪ Methodologies for reducing and reprioritizing programmed projects. ▪ Strategies for revising and reprioritizing mandated programs of projects.	Mechanisms to improve programming are expected to be addressed in the NCHRP project entitled *Factors that Support the Planning-Programming Linkage (8-50)*. DOT funding allocation practices are largely driven by unique needs and state-specific factors and politics, but agencies could benefit from a summary of current practices. A few state DOTs have recently had to significantly scale back their programs and "deprogram projects" or have founds ways to gain flexibility in delivering mandated programs. Other DOTs could benefit from the lessons these agencies have learned.	Document state DOT funding allocation approaches. Conduct notable practices/lessons learned research on agencies that have undertaken reprogramming initiatives or gained flexibility in delivering mandated programs of projects. Case Study Candidates: Virginia DOT (re-programming), Indiana DOT (re-programming), Mississippi DOT (revised mandates)
Needs Analysis and Tradeoff Analysis ▪ Improved tools and techniques for identifying needs and evaluating tradeoffs. ▪ Freight needs/benefits analysis tools.	Recent statewide long-range plan updates have taken more systematic and quantified approaches to needs identification and evaluation of alternative investment strategies, in part due to the availability of new tools, such as HERS ST. Documentation of these new, more robust approaches is needed. A number of current NCHRP studies are expected to address issues related to freight needs.	Conduct notable practices/lessons research on agencies that are using improved tools and techniques for identifying needs and evaluating investment tradeoffs. Case Study Candidates: North Carolina DOT and Kentucky Transportation Cabinet
Financial Constraint Analysis ▪ Guidance on how to integrate debt and innovative finance activities into TIP and STIP financial constraint analysis. ▪ Improved tools and methodologies for estimating future transportation funding.	While debt and innovative finance activities must be incorporated into the financial constraint analysis for TIPs and STIPs, little guidance is available on how to do so. Also, FHWA has begun to give greater scrutiny to state DOT revenue estimating assumptions that go into financial constraint analyses.	Conduct notable practices/lessons learned research on financial constraint analysis approaches. Case Study Candidates: WashCOG (DC) and Maryland DOT (in tandem); NCTCOG (Dallas/Ft. Worth) and Texas DOT (in tandem)

Activities and Associated Needs	Research Considerations	Potential Research
Benefit Analysis ▪ Methodologies for quantifying economic benefits of programs ▪ ROI analysis methodologies for preventive maintenance, congestion and safety	Significant research has been conducted over the last decade on the development of tools and methodologies for assessing the economic benefits of projects and programs. While state DOTs still identify gaps in tools and resources to assess project/ program benefits, FHWA and NCHRP/TCRP have initiatives underway to address many of theses needs (e.g., development of the AssetManager PT prototype model).	No additional research recommended.
Obtaining Resources		
Financial Analysis ▪ Tools and methodologies for analyzing tradeoffs between short- and long-term financial considerations and techniques for gap financing to keep programs on track. ▪ Tools and methodologies for analyzing the costs, benefits, and structural options for new funding and financing approaches. ▪ Tools and processes for evaluating hybrid finance structures (i.e., partial toll financing).	Decisions on whether to issue debt in order to advance projects frequently are driven more by political will than financial and economic merit. Agencies need improved tools and techniques to help them inform decision-making processes. In addition, state DOTs need information on how they can better analyze different approaches for funding and financing projects and programs. The broad topic of identifying new funding options (e.g., new tax structures, non-tax revenues, etc.), while important, is beyond the scope of this study and addressed in multiple other ongoing efforts.	Conduct notable practices/lessons learned research on agencies that have developed financial analysis tools to deal with short- and long-term considerations and tradeoffs and techniques for gap financing. Case Study Candidates: North Dakota DOT, Maine DOT, South Carolina DOT
Public-Private Partnerships (P3) ▪ Identification of policy issues and challenges associates with P3, and recommendations for addressing them. ▪ Identification of risk sharing approaches and negotiating considerations on P3 initiatives.	While a great deal of research has been conducted on P3 opportunities and barriers, the nature and range of P3 arrangements continue to evolve (e.g., emerging concession and asset sale deals). Research is needed to document the potential benefits, challenges, and institutional considerations associated with the new breed of P3 deals.	Conduct notable practices/lessons learned research on new and potential P3 deals (Given the emerging nature of this topic, further review of anticipated study efforts should be considered prior to selecting this topic area for further research). Case Study Candidates: Chicago Skyway, Texas DOT, Virginia DOT, California DOT

Activities and Associated Needs	Research Considerations	Potential Research
Tolling and Toll-Revenue Financing ▪ Expanded tools and methodologies for traffic and revenue forecasting. ▪ Guidance for balancing revenue maximization and demand management objectives when setting toll rates and policies.	Growing interest in traditional, single-facility toll projects, the emergence of new approaches such as hybrid financing and multiple-facility initiatives and HOT lanes, and poor forecasting performance for greenfield projects are generating the need for new and more robust tools to help DOTs evaluate and develop toll initiatives. These issues are being addressed in a range of studies and initiatives related to tolling and road pricing.	No additional research recommended.
Fuel Tax Alternatives ▪ New revenue mechanisms to replace current reliance on the gas tax.	Considerable research has been performed on the long-term viability of motor fuels as a primary funding source for transportation. The required level of research is beyond the scope of this project and should be handled in a separate study.	No additional research recommended.

Activities and Associated Needs	Research Considerations	Potential Research
Delivering the Program (Redefining Roles)		
Program Management Outsourcing ▪ Tools, techniques, and processes for evaluating the potential benefits, costs, and risks of outsourcing major program delivery functions and responsibilities. ▪ Identification of strategies for mitigating program management outsourcing risks and costs, and for addressing institutional barriers.	A handful of states have undertaken major program management outsourcing initiatives in recent years for portions of their construction or maintenance programs. While many of these efforts have been studied, the research has mostly focused on technical procurement issues and financing structures. Additional research is needed on institutional issues associated with program management outsourcing and approaches to support development, evaluation, and implementation of program management outsourcing initiatives.	Conduct notable practice/lessons learned research on agencies that have undertaken significant program management outsourcing initiatives. Case Study Candidates: Louisiana DOTD, South Carolina DOT, Virginia DOT, DC DOT
Preconstruction/Letting Management ▪ Tools, methodologies, and processes for coordinating preconstruction and letting schedules with cash flow considerations.	Research exists on project development streamlining, but little research has been conducted on how state DOTs control preconstruction activities from a program perspective. In particular, research is needed on how agencies can ensure the size and timing of their project development pipelines is consistent with cash flow capabilities and other agency resource constraints.	Conduct notable practice/lessons learned research on agencies that have tried to improve the coordination between project development and financial management. Case Study Candidates: TBD
Alternative Procurement ▪ Tools, methodologies, and knowledge to help state DOTs assess the benefits/costs and financial management implications of alternative procurement options such as design-build and warranties.	This topic area continues to be the subject of significant research. An important next step in this body of knowledge is to identify the institutional barriers to successful application of the approaches (e.g., organizational resistance, inadequate policies, and stakeholder concerns) and their implications for financial management (e.g., accelerated cash flow requirements). It is anticipated that future research in this well-covered topic area will address these emerging issues.	No additional research recommended.
Project Management Strategies and Systems ▪ Documentation of project management structure options and an assessment of the benefits and risks of each approach. ▪ Identification of project management system requirements and guidance for addressing these needs.	Several state DOTs have begun to explore a variety of structural and procedural options for delivering projects. These include cradle-to-grave project manager/project team approaches and centralization/decentralization initiatives. It is anticipated that the identified gaps will be addressed in the upcoming NCHRP study entitled *Guidance for Transportation Project Management (Project 20-69)*.	No additional research recommended.

Activities and Associated Needs	Research Considerations	Potential Research
Managing Finances		
Financial Accountability and Reporting ▪ Tools and techniques for tracking project level financial data on a real-time basis and imposing project cost control measures.	A variety of factors such as FHWA mega-project finance plan requirements and heightened public/stakeholder accountability expectations are pushing state DOTs to track project-level financial information more closely and control project costs. Research is needed to define the new reporting needs, document how states are responding to these increased demands, and identify successful strategies and actions.	Document new reporting requirements and conduct lessons learned research on agencies that have developed real-time project financial data tracking and reporting systems. Case Study Candidates: Colorado DOT (i.e., T-Rex), Maryland and Virginia DOTs (i.e., Woodrow Wilson Bridge), Pennsylvania DOT, Kansas DOT, others as identified
Debt Analysis and Management ▪ Methodologies for assessing appropriate program debt levels and individual debt mechanisms.	State DOT decisions about the size of innovative finance initiatives (e.g., GARVEES, TIFIA loans, SIBs) too often are driven more by political considerations than analysis of agency/state financing capacity. As such, it is unlikely that clear "best practices" for debt sizing exist within the state DOT community. Other public infrastructure areas such as the water and wastewater industries may provide valuable information. (Note: this issue also may be covered in the upcoming NCHRP synthesis project entitled *Debt Financing Practices (Project 37-11)).*	Conduct lessons learned research on agencies with new and mature debt programs. Research notable practices in other public infrastructure industries. Case Study Candidates: Colorado DOT, Missouri DOT, Oklahoma DOT, Caltrans, South Carolina DOT
Cash and Revenue Management ▪ Tools and methodologies for improved cash management. ▪ Tools and techniques for improved revenue and cash flow forecasting.	A range of considerations, such as use of alternative procurement techniques, project development streamlining, use of innovative finance techniques, and the desire to use scarce resources as efficiently as possible are creating the need for more rigorous cash and revenue management by agencies. Research is needed to document how states are responding to these increased demands and to identify successful strategies and actions.	Conduct lessons learned research on agencies that have developed new and versatile cash and revenue management and tools. Case Study Candidates: Florida DOT, Texas DOT, North Carolina DOT, Arizona DOT

4. CONCLUSIONS AND RECOMMENDATIONS FOR POSSIBLE FURTHER STUDY

4.1 INTRODUCTION

Findings from the research confirm that program delivery in a constrained fiscal environment is placing new demands on state DOTs and requiring agencies to redefine their roles across a broad range of program management activities and functions. The research also confirms that state DOTs are undergoing a period of enormous transition and that there is significant need for guidance on new or improved tools, techniques, processes, and policies across a wide array of state DOT functions.

This chapter provides the research team's preliminary recommendations regarding topic areas that are strong candidates for further study. The list of "recommended" topic areas will need to be further refined in concert with the project panel and with the goal of arriving at a cohesive and manageable set of issue areas for which meaningful progress can be made and that lend themselves to inclusion in the final guidebook. Development of the research team's preliminary set of potentially recommended issue areas was based on the following five considerations:

1. The degree to which the identified topic area and associated need is consistent with the scope of this project;
2. The probability of providing meaningful guidance based on the anticipated availability of noteworthy practices and lessons learned in a given topic area;
3. The feasibility of adequately addressing an identified need given the resources available for the project and the complexity of the associated topic area;
4. The likelihood that a need or needs will be addressed independently by other current or proposed national-level research that directly or indirectly focuses on the topic area; and
5. The extent to which activities and relevant approaches are interrelated and potentially complementary.

4.2 PRELIMINARY RECOMMENDED TOPIC AREAS FOR FURTHER STUDY

This section provides a summary list of the recommended topic areas for consideration as research candidates. Following this is a brief list of topic areas that were considered but are not recommended as candidates for further research based on application of the criteria described above. The list of candidate topic areas is organized along the four original program management functional areas along with an additional category for cross-cutting topics, as follows: 1) Cross-cutting Topics; 2) Identifying Priorities; 3) Obtaining Resources; 4) Delivering the Program; and 5) Managing Finances.

4.2.1 Recommended Candidate Topic Areas for Phase 2 Research

Following is the preliminary list of topic areas to be considered for further research. The research team anticipates collaborating with the project panel to prioritize and select from among this list prior to initiating the next study phase.

Cross-Cutting Topics

- **Institutional Capacity –** Guidance on developing in-house staff capabilities and outsourcing to meet new state DOT roles in trade-off analysis, financial analysis, public-private partnership development and implementation, debt management, and cash management.
- **Public/Stakeholder Involvement –** Guidance on public/stakeholder involvement practices related specifically to financial issues.
- **Strategic Coordination** – Documentation of agency efforts to align some or all of their strategic program delivery activities, including but not limited to strategic planning, long-range planning, performance measurement, asset management, and financial strategy.

Identifying Priorities

- **Programming, Budgeting, and Prioritization –** Documentation of state DOT funding allocation approaches and guidance on approaches to reprioritizing projects and programs.
- **Needs Analysis and Trade-off Analysis –** Guidance on tools and techniques for identifying needs and evaluating investment trade-offs.
- **Financial Constraint Analysis –** Guidance on financial constraint analysis approaches, in particular incorporating the use of debt into the required analysis and forecasting revenues derived from new and emerging funding sources.

Obtaining Resources

- **Financial Analysis –** Guidance on tools and methodologies to 1) analyze trade-offs between short- and long-term financial considerations, 2) evaluate options for gap financing, and 3) consider the costs, benefits, and structural options for new funding and finance approaches.
- **Public-Private Partnerships –** Documentation of agency experiences with new and potential public-private partnership arrangements, including but not limited to long-term concessions and asset sales, with a focus on the implications for program management.

Delivering the Program (Redefining Roles)

- **Program Management Outsourcing –** Guidance and documentation of agency experiences for program management outsourcing initiatives.
- **Pre-construction/Letting Management –** Guidance on improving coordination between project development and financial management.

Managing Finances

- **Financial Accountability and Reporting** – Documentation of financial reporting requirements and agency experiences developing and utilizing real-time project financial data tracking and reporting systems to meet those requirements.
- **Debt Analysis and Management** – Guidance on approaches for improved analysis of debt considerations and management of agency debt programs.
- **Cash and Revenue Management –** Guidance on cash and revenue forecasting, monitoring, and management tools and processes.
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4.2.2 Topics Considered But Not Recommended for Further Study

Following are topics that were considered and that are described in detail in Chapter 3 but are not recommended for further consideration based on the selection criteria applied by the research team.

- Information Management System Integration
- Tolling and Toll Revenue Financing

- Performance Measurement
- Asset Management
- Cost Estimating
- Project Management Strategies and Systems
- Fuel Tax Alternatives
- Alternative Procurement
- Benefit Analysis