Relationships Between Asset Management and Travel Demand: Findings and Recommendations from Four State DOT Site Visits

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Chapter 1. Executive Summary

1.1 Background

For more than 80 years, growth in highway travel in the United States has exceeded the growth of the public roadway network (see Exhibit 1-1). Over time, this divergence has resulted in increasing traffic congestion, travel time delays, and infrastructure deterioration, which have in turn generated a range of responses by both providers and users of the nation's highways (e.g., capacity expansions, new construction materials, and both spatial and temporal changes in travel demand). Despite these efforts, the nation's motorists and the trucking industry continue to experience ongoing reductions in roadway performance, increasing travel times, and lost productivity. In response, state highway departments (departments of transportation), county governments, and local agencies continually seek new ways to address ongoing growth in highway travel demand.

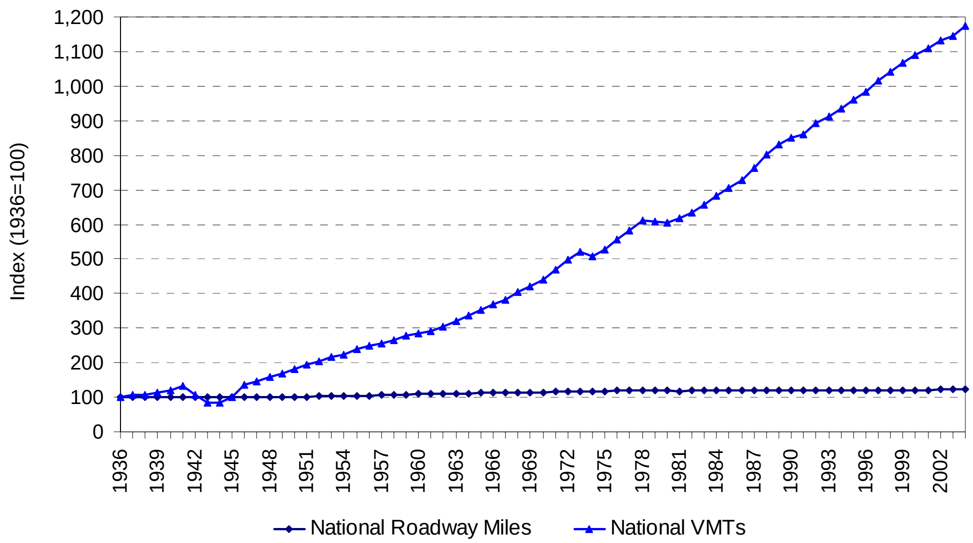

Exhibit 1-1: Growth of U.S. highway miles and vehicle-miles traveled (VMT), 1936 to 2004[1]

Over the past decade, state highway departments have also been adopting transportation assessment management (TAM) practices. TAM represents a long-term, strategic approach to the management of transportation infrastructure. A key TAM objective is the optimal allocation of limited resources to competing uses—including system preservation and capacity improvement—with the objective of maximizing transportation system performance (e.g., as measured by mobility, reliability, and safety). TAM helps to attain performance goals through the establishment of clear organizational objectives, performance measures, quality information sources, effective business processes, and robust decision-making tools.

[1] U.S. Department of Transportation. *Highway Statistics to 1995*. Updated December 2005. Accessed May 2006.

1.2 Study Objectives

This study seeks to determine how state departments of transportation (DOTs) are using TAM and related techniques to address existing and anticipated future travel demand. Correspondingly, this study attempts to identify and document *all* cases in which state DOTs have incorporated travel demand measures within TAM and related analyses and decision-making processes. At a minimum, the study set out to determine how state DOTs are addressing the following issues:

Current and projected travel demand measures as inputs to the TAM process

1. *Infrastructure deterioration (e.g., roadway wear):* Increasing traffic volumes and vehicle weights result in increasing rates of roadway deterioration. How do state DOTs take current and projected travel demand measures into account when evaluating the *current* maintenance and rehabilitation needs of existing roadway infrastructure? Are state DOTs using current and/or projected travel demand measures to help *project* the timing and magnitude of future rehabilitation and replacement needs?

2. *Re-investment prioritization:* The benefits of reinvesting in existing infrastructure tend to be highest for segments with relatively greater customer utilization. How are state DOTs using TAM and related techniques to prioritize roadway re-investment between and within regions based on current and projected future utilization?

3. *Project benefit-cost and alternatives analysis:* The cost effectiveness (or return on investment) of major new investments and the relative benefits of project alternatives are heavily influenced by travel-time savings. How are state DOTs incorporating travel-time savings into their selection processes for major projects?

Using the TAM process to address issues related to travel demand

4. *Capacity improvements:* As noted above, the rate of growth in travel demand remains well above the rate of growth in roadway capacity, which leads to increasing congestion and travel times. Have state DOTs adopted TAM-related practices to help identify capacity improvement strategies or for prioritizing potential expansion investments?

5. *Safety improvements:* Increasing roadway utilization also brings increasing opportunities for crashes, injuries, and fatalities. How are the safety implications of current and future travel demand for both light- and heavy-duty vehicle traffic factored into system management decisions?

6. *Trade-offs between preservation and capacity needs:* All state DOTs face the problem of balancing investment in existing roadway capacity with the need for additional capacity to address growing demand, all within limited financial resources. How have TAM and related processes been used to allocate funds between these and other competing needs, and how do travel demand measures inform this allocation?

7. *Objectives and performance measures:* TAM emphasizes the need to establish long-term system objectives and develop processes and measures to evaluate success in attaining those objectives. How do state DOTs propose to measure and report performance relative to travel demand? Have they identified or established desired performance standards with

respect to roadway volumes, congestion, and other travel demand related measures? If not, why?

8. *Long-term planning and budgeting:* TAM emphasizes the need to take a long-term, strategic view in establishing attainable organizational objectives within realistic resource constraints. Given these objectives, how do state DOTs incorporate travel demand forecasts into their long-term investment plans? How are those plans constrained by existing resources? How are long-term travel demand and budgeting concerns incorporated into agencies' strategic plans? How long is the long term?

1.3 Study Approach and Sample States

The study collected data on the asset management, travel demand forecasting, and related practices of four state DOTs: California (Caltrans), Michigan (MDOT), North Carolina (NCDOT), and Utah (UDOT). The data were collected during two to three full days of onsite interviews with key staff at each agency, including asset managers, travel demand modelers, short- and long-range planning staff, short- and long-term programming and budgeting staff, roadway maintenance staff, operations personnel, and IT and database maintenance staff. Interviews were intended to document the following:

1. The extent and maturity of each state's asset management program
   - Structure and role within broader DOT organization
   - Program goals and objectives
   - History and development
   - Capabilities
   - Future plans
   - Dedicated resources

2. How DOTs use TAM to address travel demand issues
   - Collection of current and projected travel demand measures
   - Uses of travel demand measures in support of asset management
   - Intermodal, interstate, and international traffic flow considerations
   - Current operations and maintenance

3. How DOTs address their long-term investment needs
   - Long-term transportation planning
   - Long-term budgeting
   - Strategic transportation planning (How does asset management inform or shape each state's infrastructure and financial plans?)

The sample states were selected to provide a broad representation of highway network features, travel-demand characteristics, system size, population growth, urban concentration, industry, climate, and topology. States were also selected to include some of the more advanced in the adoption of TAM practices.

California, Michigan, North Carolina, and Utah met these selection criteria. For example, these states encompass a wide range of state-maintained network sizes (NCDOT is responsible for close to 170,000 lane miles versus just 15,000 for UDOT), varying shares of urban versus rural roadways (25 percent of Caltrans-maintained roadways are urban versus just 12 percent for NCDOT), a range of population and vehicle miles traveled (VMT) growth rates (urban annual VMT growth is 2 percent in California and Michigan but exceeds 3 percent in Utah and North Carolina), and wide variations in congestion (urban average annual daily traffic (AADT) per lane mile exceeds 17,000 in California but is only 4,000 in North Carolina).

1.4 Key Findings

State DOTs have made great strides over the past decade in implementing TAM processes for a broad range of investment and strategic management activities. These TAM processes required significant investments in data collection and database maintenance, decision-support tool development, business process re-engineering, and human-resource development. However, even with these significant investments, progress in incorporating travel-demand measures into state TAM programs remains in its infancy. The following is a summary of the study's key findings:

- **TAM programs:** Each of the agencies interviewed already has either elements of or strong foundations for a TAM program. For example, three of the agencies studied have established asset management programs. All of the states utilize both pavement and bridge management systems and data collection processes for maintaining the asset inventories used by management systems. In addition, most states maintain current databases of some other highway assets, including the location and condition (or age) of guard rails, drainage, signage, and a variety of other ancillary assets. Beyond these core programs, most states also maintain one or more decision-support tools designed to assist in selecting among a mix of potential rehabilitation options. For two of the study states, asset management analyses were either reflected in or very closely tied to development of the Statewide Long-Range Transportation Plan (SLRP). Each state indicated a strong interest in further advancing its asset management program with several agencies actively participating in further development actions.

  The TAM programs for each of the four participant states remain primarily focused on system maintenance and preservation. This focus reflects the history of each program's development (developing from a kernel of pavement and bridge management systems) and the particular investment needs, legislative requirements, and "color of money" limitations within each state. Moreover, most agencies tend to focus on the short- to medium-term investment needs, but place less emphasis on long-term objectives (e.g., mitigating congestion). This emphasis is reflected in their TAM program goals and objectives, which are also primarily focused on maintenance and preservation.

- **Travel demand forecasts and TAM:** Each of the agencies interviewed maintains some level of travel demand forecasting capability. These resources are used primarily as either technical support to local metropolitan planning organizations (MPOs) and rural planning organizations (RPOs)—in many instances, the state's travel demand modelers develop and operate the travel demand models for the smaller MPOs and RPOs—or to support cost-effectiveness analyses of major investment projects. Two of the four states interviewed maintained statewide travel demand models of sufficient quality to support development of a long-term, strategic assessment of state-wide capacity requirements or future performance expectations.

- **Measures of current travel demand:** In addition to generating long-term travel demand forecasts, each state also actively maintains databases of current travel demand (e.g., traffic counts, VMTs, truck counts) for all state-maintained facilities. Measures of current travel demand are generally available to all interested DOT staff, but are most often used by: (1) travel demand modelers as raw model input data, (2) managers with responsibilities for the preservation of bridges, pavement, and highway asset types, and (3) external users including MPOs, RPOs, municipalities, researchers, and even state residents.

Current and projected travel demand measures as inputs to the TAM process

- **Infrastructure deterioration (e.g., roadway wear):** Increasing traffic volumes and vehicle weights should result in increasing rates of roadway deterioration.

  While current travel demand volumes are frequently considered *implicitly* by agency management systems (e.g., through annual segment-by-segment roadway condition evaluations), these measures are rarely incorporated *explicitly* into assessments of asset deterioration rates or the subsequent maintenance and rehabilitation requirements. Similarly, projected future travel demand volumes have not been used to model long-term maintenance and preservation needs.

- **Re-investment prioritization:** The benefits of reinvesting in existing infrastructure tend to be highest for segments with the highest travel demand (i.e., as there are more users to benefit from the improvements).

  Only one of the four study states (Utah) has developed a decision support tool that utilizes travel demand-driven investment benefits to help prioritize near-term preservation investments between locations or regions (i.e., where preservation activities in high utilization links can be prioritized over low demand links for a similar deficiency based on the higher benefits associated with higher volume traffic). While the other states do not *explicitly* include travel demand measures in their statewide investment prioritization, travel demand considerations are *implicitly* reflected through their traditional project review processes.

- **Project benefit-cost and alternatives analysis:** The cost-effectiveness (or return on investment) of major new investments and the relative benefits of project alternatives are heavily influenced by aggregate travel-time savings.

  Virtually all of the participant states regularly conduct benefit-cost analyses (or other cost-effectiveness assessments) of proposed major investment projects as well as their investment alternatives. A primary source of investment benefits for these projects is the estimate of aggregate travel-time savings for all travelers projected to use a proposed investment.

Using the TAM process to address issues related to travel demand

- **Capacity improvements:** As noted above, the rate of growth in travel demand remains well above the rate of growth in roadway capacity, leading to increasing congestion and travel times. Have state DOTs adopted TAM-related practices to help identify capacity improvement strategies or for prioritizing potential expansion investments?

  As noted above, two of the four participant states (Michigan and California) maintain statewide travel demand models, and one (Michigan) maintains a truck model. Development of these tools is critical to the objective and consistent identification and assessment of those travel corridors (both current and future) expected to suffer most from travel demand growth and, hence, having the highest priority investment needs. Combing the data from these forecasting tools with other travel-related metrics, Michigan has identified and prioritized capacity investment needs for several "corridors of highest significance."

- **Trade-offs between preservation and capacity needs:** All state DOTs face the problem of balancing investment in existing roadway capacity with the need for additional capacity to address growing demand—all within limited financial resources. How have TAM and related processes been used to allocate funds between these and other competing needs, and how do travel demand measures inform this allocation?

  None of the four states interviewed has yet succeeded in developing an objective process or a decision-support tool to optimize the allocation of funds across multiple investment uses (e.g., preservation, capacity improvements, safety, and roadside maintenance). To a certain extent, these states have not addressed this possibility due to the existence of state legislation requiring the prioritization of preservation activities over capacity improvements (or the reverse) or due to "color-of-money" constraints at both the state and federal levels. A key exception here is Utah, which is working through the problem of establishing a robust benefit-cost process capable of making "apples-to-apples" comparisons between preservation and capacity improvement activities.

- **Objectives and performance measures:** TAM emphasizes the need to establish long-term system objectives and to develop processes and measures to evaluate success in attaining those objectives.

  The current goals and objectives of the participant states' TAM programs reflect the current focus of these programs (i.e., maintenance and preservation) and, hence, place little emphasis on travel demand-related concerns (e.g., congestion). In contrast, each DOT's agency-wide goals and objectives, as expressed in strategic documents such as their SLRPs, tend to be broader in scope and typically include the maintenance and improvement of mobility as a key goal.

- **Long-term planning for growth in travel demand:** What are state DOTs doing to plan for long-term travel demand growth?

Each of the state DOTs interviewed has identified long-term strategies to address the issue of ongoing, long-term growth in travel demand. These strategies are most clearly expressed in each DOT's SLRP. While the mix of strategies to address travel demand issues varied by state, these strategies generally included the following measures:

- Increased capacity (e.g., lane and bridge widening)
- Travel demand management (TDM) strategies (e.g., telecommuting, real-time information, ridesharing)
- Operational improvements (e.g., ITS, improved incident management)

- **Long-term budgeting:** TAM emphasizes the need to take a long-term, strategic view in establishing attainable organizational objectives within realistic resource constraints.

  The long-range budgeting processes used by state DOTs are somewhat rudimentary and have the primary objective of supporting preparation of the SLRP. According to state DOT staff interviewed for this study, long-range budget analyses have no regular "audience" beyond production of the SLRP. The SLRP for each of the four study states provides an analysis of its current revenue situation, while three of the four plans provide an analysis of the projected gap between long-term needs and anticipated future funding. Only one of the four participant states (Utah) prepared a long-term budget cash-flow projection showing the sources and uses of DOT capital and operating funds over the time horizon covered by its SLRP.

1.5 Recommendations

This study resulted in the following recommendations for state DOTs to enhance their existing transportation asset management programs. Also, based on comments received from state DOT staff participating in this study, a second subsection identifies ways in which the Federal Highway Administration (FHWA) may provide related support to the state DOTs.

1.5.1 Suggestions for State DOTs

- **Refine asset deterioration models (short- and long-term):** While some participant states (most notably Utah and Michigan) have worked hard to develop good preservation investment tradeoff tools (focused on short-term preservation needs and strategies for a specific asset type—for example, pavement), none of the four states has developed a comprehensive long-term (i.e., 20-year) asset deterioration model that estimates capital reinvestment needs across *all* asset types and *all* regions (i.e., similar to HERS-ST). On the broader asset management front, such tools are critical in evaluating long-term funding requirements for asset preservation. Such models can also be used to evaluate the impact of changes in travel demand volumes (e.g., current and projected auto and truck VMTs) on asset deterioration rates and reinvestment needs. This analysis can help pinpoint which network assets are likely to most require future preservation investments.

- **Develop statewide auto and truck travel demand models:** Statewide travel demand and truck forecasts provide the data required to think strategically about where to focus long-term preservation and capacity investment funds. The construction of such models is key to ensuring an understanding of current and future system performance (volumes, congestion, trade flows) across their highway network. In support of this objective, FHWA may wish to help foster informational exchanges in the design and maintenance of statewide auto and truck travel demand models.

- **Ensure consistency in project prioritization across regions and districts:** For many state DOTs, the process of project prioritization takes place primarily within the DOT's district or regional offices (typically followed by some limited reprioritization between regions by headquarters staff). Moreover, it is not uncommon for this project prioritization process to vary appreciably from one state DOT district to the next. Such processes lack interregional consistency and, hence, may yield sub-optimal allocations of scarce investment funds. If they are not already doing so, state DOTs need to develop objective and consistent processes and tools to help prioritize investments by region. Such processes should recognize that investment benefits are generally higher on those segments with high travel demand.

- **Ensure consistency between TAM program and SLRP:** State DOTs should view their SLRPs as a key component of their asset management programs. At a minimum, the goals, objectives, and strategies of the SLRPs should be highly consistent and/or complementary with those of the asset management programs and developed in coordination with asset management staff. Optimally, the SLRP should be recognized as a key component of the asset management program (providing a strategic roadmap for the future), with joint production responsibilities across planning, asset management, budget, upper management, and other key agency staff.

- **Long-range budgeting:** State DOTs should consider adopting the practice of preparing and maintaining a comprehensive long-range (i.e., 20-year) budget as a means of more effectively identifying and prioritizing financially attainable long-term investment solutions and performance objectives. A comprehensive long-term budget should include a detailed cash-flow analysis showing the anticipated sources and uses of all capital and operating funds over a long-term forecast horizon. Plans should also be founded on realistic and conservative assumptions regarding rates of inflation and the future funding capacity of state and federal funding sources.

- **Improved coordination with county and local governments:** With the exception of North Carolina DOT (which holds responsibility for more than 80 percent of all roadway miles statewide), the state DOTs interviewed for this study are responsible for, at most, 15 percent of the total roadway miles within each state. Hence, the vast majority of the roadway investment and maintenance activities conducted within each state are managed independently by a number of county and local governments. Therefore, the effective development and deployment of a truly *statewide* strategic TAM program requires both (1) the existence of TAM programs at the local and regional level, and (2) coordination of program metrics, objectives, and execution across all levels of government including state, regional, county, and local. Note that Michigan and Utah both have local and regional TAM programs that coordinate with and frequently obtain technical support from their state's DOT. State DOTs should work to promote TAM practices within the state at the county and local level and work with the state's regional, county, and municipal governments to jointly identify, define, and pursue consistent, statewide TAM practices and objectives.

1.5.2 Suggestions for FHWA

- **Technical guidance:** Each of the state DOTs participating in this study indicated a strong interest both in advancing its own asset management program and in learning more about how other states (or other organizations with large asset bases) were addressing similar TAM-related issues. At the same time, these states are striving to derive operational solutions to technical issues associated with the implementation of asset management processes—in many cases, working in isolation from one another in solving the same, fundamental technical problems. Examples include the development of comprehensive capital asset databases, robust decision support tools, deterioration curves that take account of current travel demand and future travel forecasts, and meaningful performance measures.

  Based on these and related observations, it is clear that the states would both benefit from and appreciate technical assistance in solving the technical issues associated with making asset management concepts operational. In this regard, many agencies interviewed were well aware of the problems they wanted to solve (e.g., develop metrics capable of effectively assessing investment tradeoffs between rehabilitation and capacity improvements), but lacked the specific technical methods required to develop the associated support tools. Several respondents also suggested that the current asset management literature has proven highly useful in helping to identify the high-level structure, goals, and objectives of a successful TAM program, but offers less in terms of specific solutions to technical issues. The recommendation here is not to provide a single set of solutions that all agencies are expected to follow, but rather a set of suggested approaches to key technical issues (from which agencies can build their own solutions). Specific technical issues to address include:

  - *Prioritization and tradeoff analysis:* Many agencies lack analytic methods or capabilities to assess investment tradeoffs among highway asset types (including pavement, bridges, signage, landscaping, etc.); among regions; and among operations, preservation, and expansion.
  - *Performance measures:* Each of the four states interviewed has adopted or is in the process of adopting statewide transportation performance measures. The types of measures in use or being considered vary widely from state to state. To some extent, this disparity reflects variations in the primary focus of each state's asset management program as well as differences in each state's long-term goals and objectives. However, these differences also reflect varying levels of experience in the development and maintenance of performance measurement systems such that one state suggested it would be beneficial to have further technical support from FHWA in this area (e.g., best practices and information exchange sessions).
  - *Comprehensive asset inventory development:* While most agencies have quality inventories of pavement and bridges, most agencies do not have a single comprehensive inventory of all highway infrastructure assets (e.g., drainage systems or rest area assets). A comprehensive database is valuable in conducting tradeoff analyses of reinvestment between multiple asset types.

- **Legislative constraints:** Existing legislation within each of the sample states as well as program requirements for several federal sources (e.g., federal aid funds) can restrict a state DOT's ability to use asset management techniques to optimize the allocation of funds. For example, North Carolina has a legislative requirement to complete build-out of the state's intrastate highway system, a mandate that is counter to the state's increasing need for preservation expenditures. Similarly, federal aid funds such as the Highway Bridge Replacement and Rehabilitation Program limit the application of funding capacity to a specific purpose, which may not reflect prioritized investment needs. Congress may wish to consider options by which funds with specific uses may be diverted to alternate uses if justified by supportable analyses. Similarly, state DOT representatives may wish to work directly with state regulators to loosen the fixed funding priorities embedded within existing state transportation legislation (if they conflict with the findings of their asset management programs).

Chapter 2. Introduction: Trends in Asset Management and Travel Demand

2.1 Introduction

Over the past decade, state DOTs have increasingly adopted TAM practices as a means of better managing the condition and performance of their highway infrastructure. Over the same period, states have also experienced unprecedented levels of roadway congestion and travel delays—the result of decades of continuous growth in travel demand. The objective of this study is to determine how state DOTs are applying the methods and objectives of TAM as a means of addressing sustained travel demand growth and its impacts on highway infrastructure needs and performance.

This chapter has two objectives. First, it provides a brief overview of TAM as it is currently defined in the U.S. transportation community, including its principles, objectives, and techniques. Second, it provides a review of recent and long-term trends in U.S. highway travel demand (both for private autos and commercial vehicles), highway capacity, congestion, and travel delay costs.

Given this background, the succeeding chapters of this report focus on how a sample of four U.S. state DOTs are applying asset management principles (either explicitly or implicitly) to address the challenges related to ongoing growth in travel demand. Specifically, Chapter 3 describes both the specific questions to be addressed by this study and the approach used to answer those questions. It also provides a comparative analysis of the four states selected for the study: California, Michigan, North Carolina, and Utah. Chapter 4, the core of the report, provides an overview of the current asset management programs of all four states as well as their current travel demand capabilities. It also examines how these two capabilities are being jointly used to address short- and long-range travel demand issues. Chapter 5 examines SLRPs and long-range budgeting, their potential roles as part of the TAM process, and their roles in addressing travel demand issues. Finally, Chapter 6 summarizes the conclusions of this report and presents recommendations—both to FHWA and to state DOT staff—on potential future improvements to federal and state practices.

2.2 Adoption of TAM

TAM is a strategic approach to managing transportation infrastructure. It focuses on business processes for resource allocation and utilization with the objective of better decision-making based upon quality information and well-defined objectives. It includes strategic approaches to inventorying, monitoring, investing, and managing, at desired levels of performance, the many different assets that constitute a transportation system, and it provides a framework for the efficient allocation of resources by transportation agencies. Transportation assets range from physical infrastructure to information to human capital. Fully implemented transportation asset management leads to better-informed investment decision making and has the potential to reduce the gap between increasing investment requirements—driven by population growth, economic growth, and socioeconomic changes—and available financial resources.

TAM methods have been widely deployed in several other developed countries—including Britain, Canada, New Zealand, and Australia—for more than two decades. Although a more recent phenomenon in the U.S., TAM has become widely adopted over the past decade with virtually all state DOTs now practicing some form of asset management, most typically in the form of pavement, bridge, maintenance, and safety management systems. In addition, many states are now moving beyond these "baseline" management systems for assets to embrace the wider definition of asset management as provided in the preceding paragraph. Specifically, some agencies have implemented or are working to implement one or more of the following asset management techniques/functions:

- Identification of agency-wide goals and objectives
- Development and maintenance of comprehensive asset inventories (including pavement, bridges, signs, signals, guard rails, rest areas, drainage, etc.)
- Completion of ongoing system condition and performance assessments
- Development and implementation of investment tradeoff tools (not just within a given asset type but between asset types; sub-regions; and preservation, expansion, safety, and operational investments)
- Monitoring of a set of key performance measures.

The relationship between these and other asset management functions is outlined in Exhibit 2-1.

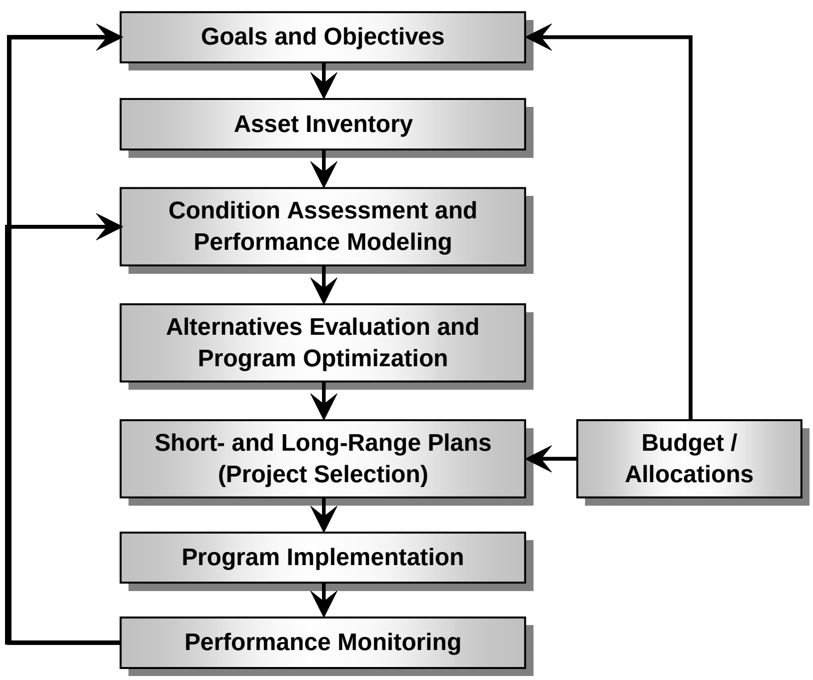

Exhibit 2-1: Primary TAM functions and their relationships

FHWA believes that, as a relatively new initiative in the U.S. transportation community, a demonstration of current TAM practices at a sample of state DOTs will prove useful to other transportation organizations working to implement or improve their own asset management programs. Therefore, one objective of this study is to document the current TAM practices used by a sample of four U.S. state DOTs. Given the study's focus, the *primary* study objectives are to document how travel demand measures are being used as *inputs* to TAM processes (e.g., how do current measures of truck VMTs impact pavement preservation needs?), and how TAM processes are being used to impact the *outcome* of travel demand-related issues (e.g., congestion). Note here that both current and projected travel demand measures are *inputs* to TAM processes, while the potential to mitigate travel demand-related problems is an *output* of the TAM process.

2.3 Trends in Highway Capacity and Travel Demand

Over the past 25 years, the nation's population, economy, and vehicle ownership have all grown much faster than total highway lane-miles—a fundamental measure of highway capacity. From 1980 to 2004, population increased at an average annual rate of 1.06 percent, the gross domestic product (GDP) grew at an average annual rate of 3.11 percent, and the number of vehicles increased at an average annual rate of 1.68 percent. Total highway lane-miles, on the other hand, increased at an average annual rate of only 0.21 percent from 1980 to 2003. Furthermore, population is expected to increase at 0.88 percent per year from 2004 to 2015 (from 292 million to 321 million), and the economy (measured by GDP) is expected to grow at 3.09 percent per year in the same time period. Exhibit 2-2 indicates a clear divergence between the increasing demands for transportation services and nearly static highway capacity. Without a dramatic increase in capacity investment, this diverging pattern will undoubtedly continue.

There is also a divergence between highway usages and highway capacity. From 1990 to 2003, passenger-miles traveled (PMT) increased at an average annual rate of 2.20 percent, VMT increased at an average annual rate of 2.32 percent, and truck ton-miles increased at an average annual rate of 3.06 percent. During the same period, total highway lane-miles increased at an average annual rate of only 0.25 percent. Passenger cars and other 2-axle, 4-tire vehicles together account for well over 90 percent of both total highway PMT and VMT over the last two and a half decades. Exhibit 2-3 shows the divergence between the growth of highway usages and that of highway capacity. Among the three measures, truck ton-miles had the fastest growth, which was the result of a sustained increase in the share of truck ton-miles in the total ton-miles of freight in the U.S. In the 1990s, trucks accounted for less than 24 percent of U.S. total ton-miles of freight, but maintained a sustained growth to over 29 percent of U.S. total ton-miles of freight in 2003 (see Exhibit 2-4). Despite the rise of air passenger transportation, from less than 3 percent of U.S. total PMT in 1960 to over 10 percent in the 1990s, highway PMT still accounted for 89 percent of total U.S. PMT in 2003.

Measured by average daily load and average daily traffic, the increase of highway usage intensity on the interstate system greatly outpaced the growth of interstate lane-miles in both urban and rural areas (Exhibit 2-5). Note that the decline of lane-miles in rural areas and the accelerated growth of lane-miles in urban areas may be due to the reclassification of rural into urban interstate functional systems due to the expansion of urbanized areas.

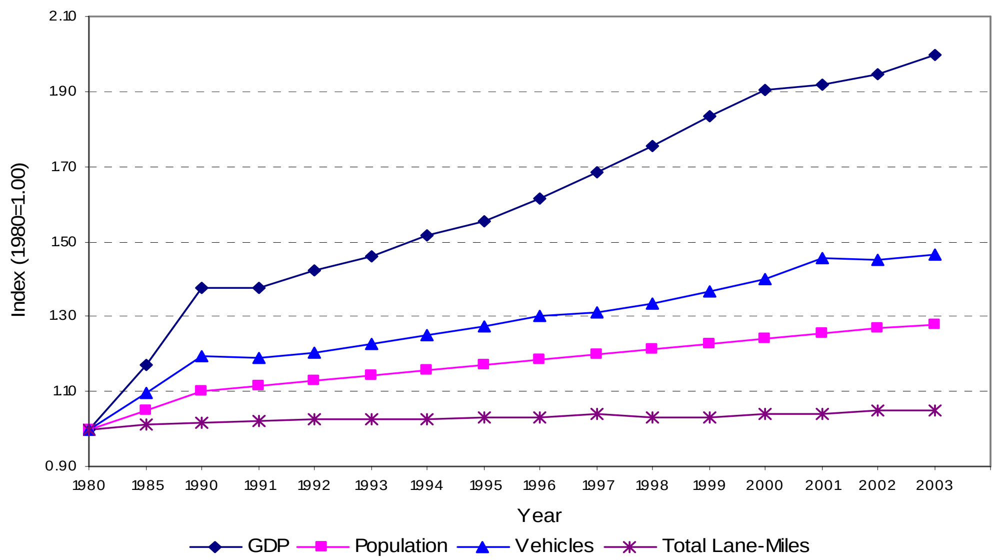

Exhibit 2-2: Growth of population, GDP, vehicles, and total highway lane-miles[2]

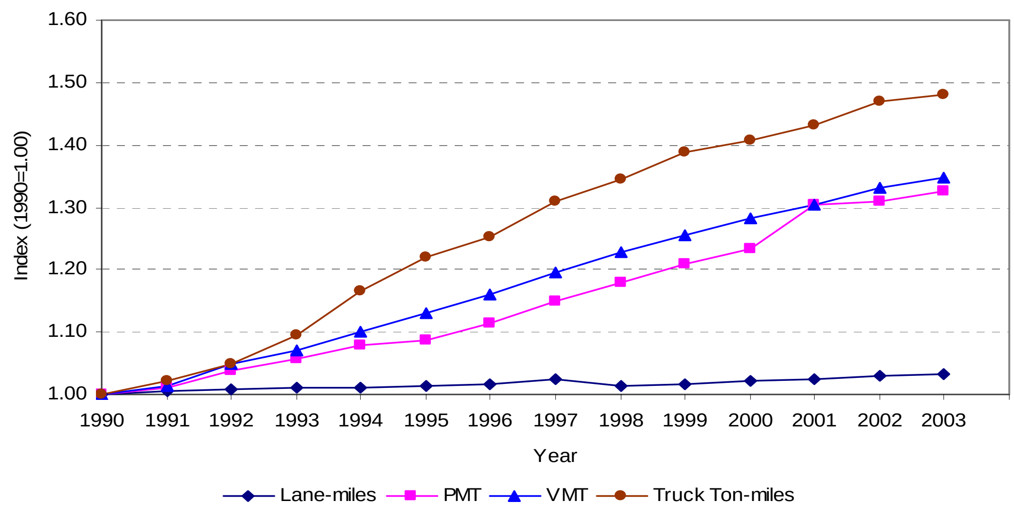

Exhibit 2-3: Growth of PMT, VMT, truck ton-miles, and total highway lane-miles[3]

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[2] Population data are from U.S. Census Bureau, *Statistical Abstract of the United States, 2004-2005*. GDP is from Bureau of Economic Analysis, "National Income and Product Account Tables," Table 1.1.6., available at http://www.bea.gov/ December 2005; and U.S. Congressional Budget Office, *The Budget and Economic Outlook*, August 2005. Data on vehicles and total highway lane-miles are from Department of Transportation, *National Transportation Statistics 2005* as of December 9, 2005.

[3] Sources: Data is from, Department of Transportation, *National Transportation Statistics 2005*, as of December 9, 2005.

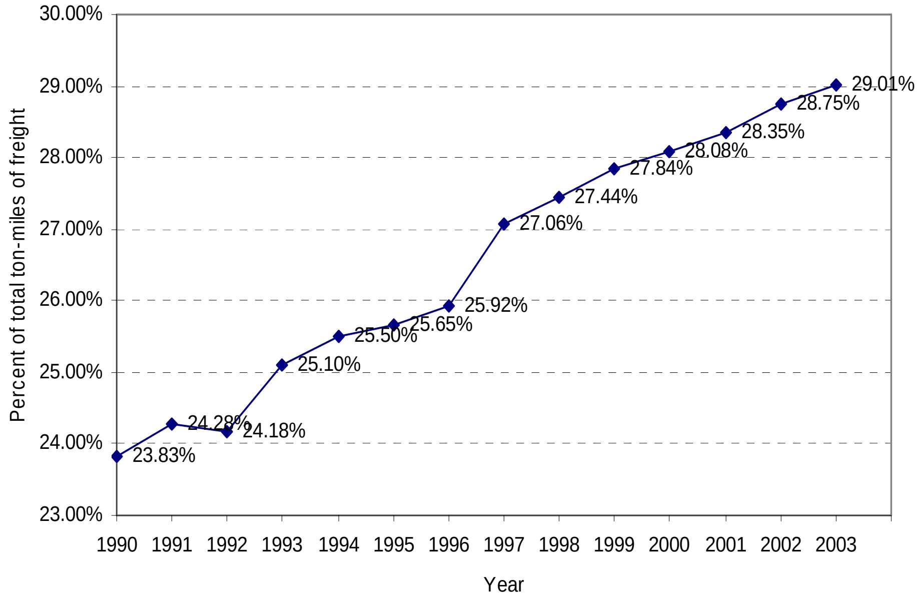

Exhibit 2-4: Growing share of truck ton-miles as percentage of total U.S. freight ton-miles[4]

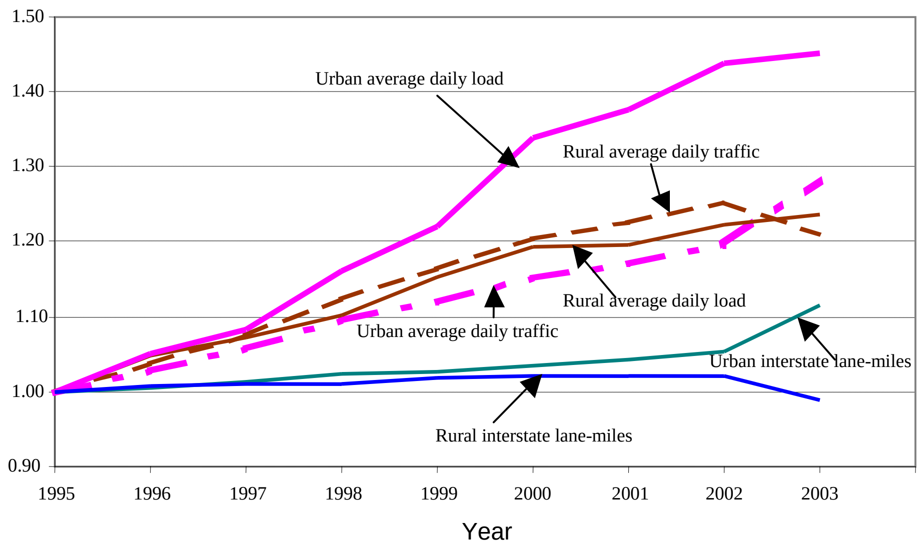

Exhibit 2-5: Growth in capacity, volume, and loadings on the Interstate system (Index: 1995=1)[5]

4 Department of Transportation, *National Transportation Statistics 2005*.

5 Loadings are based on equivalent axle loads that are the damage to a pavement caused by a vehicle axle relative to an 80 kN (18,000lb) force that represents a standard single axle. Source: Based on data on daily traffic volume and load from Federal Highway Administration, Highway Statistics 2003, at http://www.fhwa.dot.gov/policy/ohim/hs03/htm/tccht.htm. Data on interstate lane-miles are from Department of Transportation, National Transportation Statistics 2005.

The sustained population and economic growth and rapidly increasing highway usage have put great pressure on the highway system. There is a divergence of road pavement conditions between rural and urban areas and across highway functional systems. While road pavement conditions in rural areas have improved, road pavement conditions in urbanized areas have actually worsened. In rural areas, the average share of total mileages in acceptable and good conditions increased from 86.2 percent in 1995 to 91 percent in 2002, and the share of mileages in good condition increased from 44.7 percent to 50.9 percent. In small urban and urbanized areas, however, the average shares of both acceptable and good condition mileages declined in the same period. The percentage of total mileage in acceptable condition declined from 81.7 percent to 80.6 percent in small urban areas, and from 81.7 percent to 75.9 percent in all urbanized areas.

In 9 of the 14 highway functional classifications, there was an increase in the percentages of mileage in acceptable conditions from 1995 to 2002. Over 90 percent of all interstate highways in both urban and rural areas were in acceptable conditions. However, the percentages of road mileage in acceptable condition declined in five other highway functional classifications, which included small urban minor arterials, small urban collectors, urbanized other principal arterials, urbanized minor arterials, and urbanized collectors. For example, the acceptable mileages of urbanized, other principal arterials declined by over 8 percentage points, from 75.9 percent in 1995 to 67.5 percent in 2002.

The divergence of road pavement conditions across highway functional classifications is even clearer when the percentages of mileage in good condition are compared. Only 7 of the 14 highway functional classifications had an increase in the percentages of mileage in good conditions. Seven other highway functional classifications had declining shares of mileages in good conditions. All these declining highway classifications were at lower levels, including rural major collector, small urban other principal arterial, small urban minor arterial, small urban collector, urbanized other principal arterial, urbanized minor arterial, and urbanized collector. The largest declines were in urbanized collector (10.9 percentage points), rural major collector (10.6 percentage points), and small urban collector (10.3 percentage points). In 2002, less than one quarter of urbanized other principal arterial and only about one-third of small urban collector and urbanized collector miles were in good condition. Clearly, urban areas are facing greater challenges in improving their road pavement conditions.

Overall, the conditions of the nation’s bridges have largely improved while the total number of bridges has increased. The total number of deficient bridges decreased from 238,220 in 1990 to 158,319 in 2004 (i.e., a decrease of 34 percent). The improvement of bridge conditions is attributed to the improvement in the decline of rural deficient bridges and in the decline of urban structurally deficient bridges (Exhibit 2-7). However, urban functionally deficient bridges increased by over 15 percent in more than a decade, from 26,243 in 1992 to 30,298 in 2004 (Exhibit 2-6).

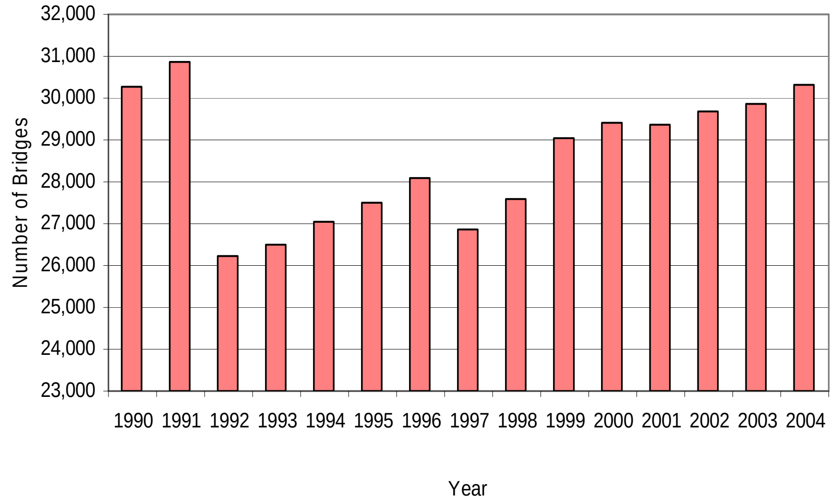

Exhibit 2-6: Urban functionally deficient bridges in 1990-2004[6]

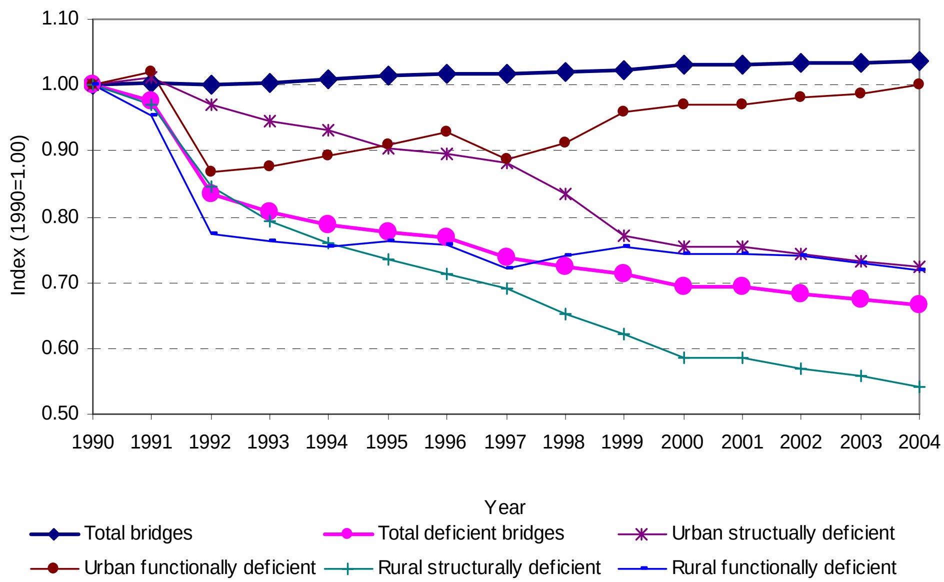

Exhibit 2-7: Growth of total and deficient bridges, 1990-2004[7]

Urban areas face greater challenges and more severe problems. Urban and rural VMT per lane-mile increased from 1990 to 2003 by 12 percent and 28 percent, respectively. Nevertheless, the

[6] Note: Functionally deficient bridges are defined as those that do not have the lane widths, shoulder widths, or vertical clearances adequate to serve traffic demand, or that may not be able to handle occasional roadway flooding. Source: Department of Transportation, *National Transportation Statistics 2005.*

[7] Note: Structurally deficient bridges are defined as those needing significant maintenance attention, rehabilitation, or replacement. Source: Department of Transportation, *National Transportation Statistics 2005.*

intensity of highway usage is far greater in urban areas than in rural areas, although the difference declined from about 5 times greater in 1990 to 4 times greater in 2003 (Exhibit 2-8).

Urban congestion has worsened over the last two decades across urbanized areas of all sizes. Average annual delay per traveler in peak hours grew from 16 hours in 1982 to 47 hours in 2003.[8] Roadway congestion indices and travel time indices continued to increase in the last two decades. For the 85 urbanized areas surveyed, the average roadway congestion index rose from 0.81 in 1982 to 1.17 in 2003, which means roadway traffic volume increased from below roadway capacity in 1982 to exceeding roadway capacity by 17 percent in 2003 (Exhibit 2-9). The travel time index increased from 1.12 in 1982 to 1.37 in 2003, which means that a 20–minute, free-flow trip took 22.4 minutes in the peak hours in 1982 and 27.4 minutes in the peak hours in 2003 (Exhibit 2-10). In 2003, urban congestion resulted in a total of 3.7 billion hours delay and 2.3 billion gallons of wasted fuel, which cost a total of $63.1 billion.

Safety is always of great concern in transportation. Although the fatality rate per 100,000 VMT is dropping, the total number of accidents has not decreased. As a result, it is difficult to determine through crash rates alone whether increasing VMT have positive or negative impacts on safety.

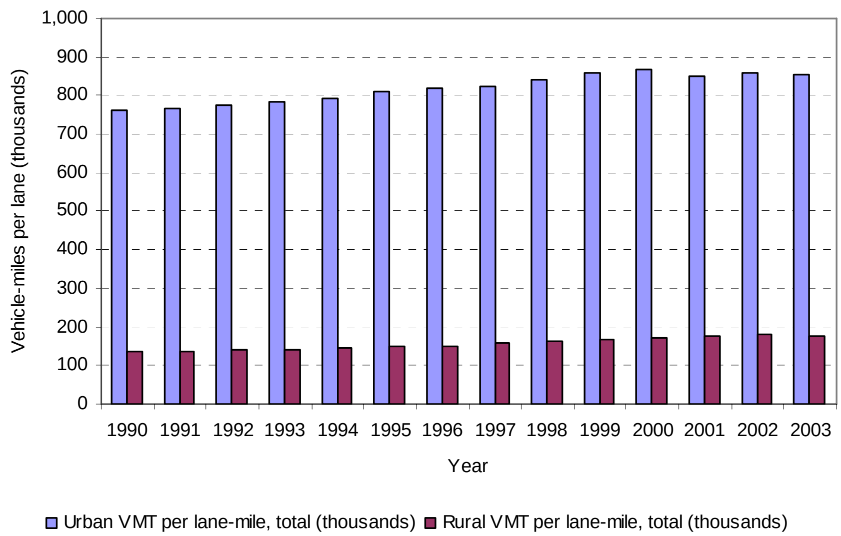

Exhibit 2-8: Urban and rural VMT per lane-mile[9]

[8] Texas Transportation Institute, The 2005 Urban Mobility Report, May 2005. http://mobility.tamu.edu.

[9] Department of Transportation, *National Transportation Statistics 2005*.

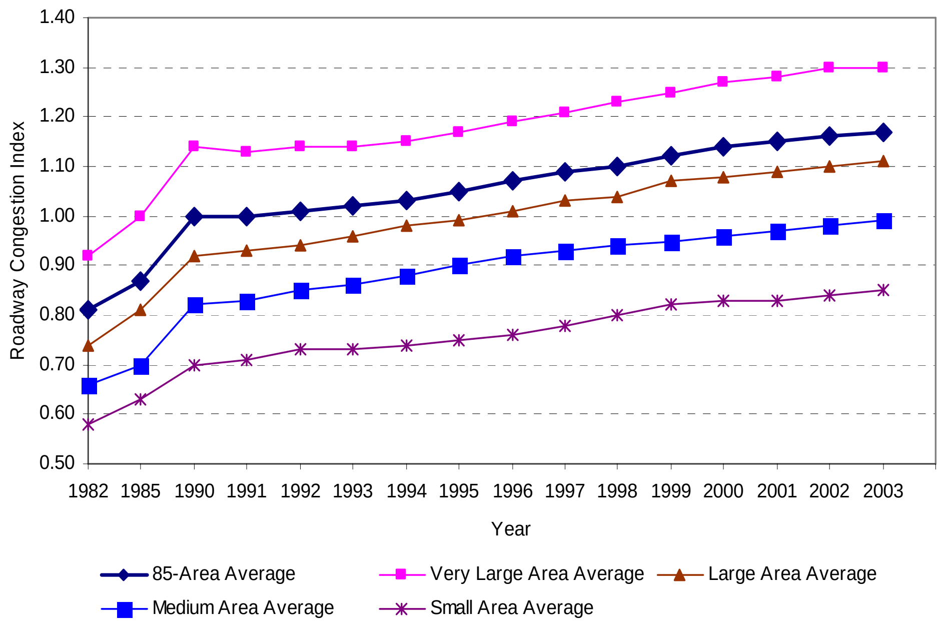

Exhibit 2-9: Roadway congestion index[10]

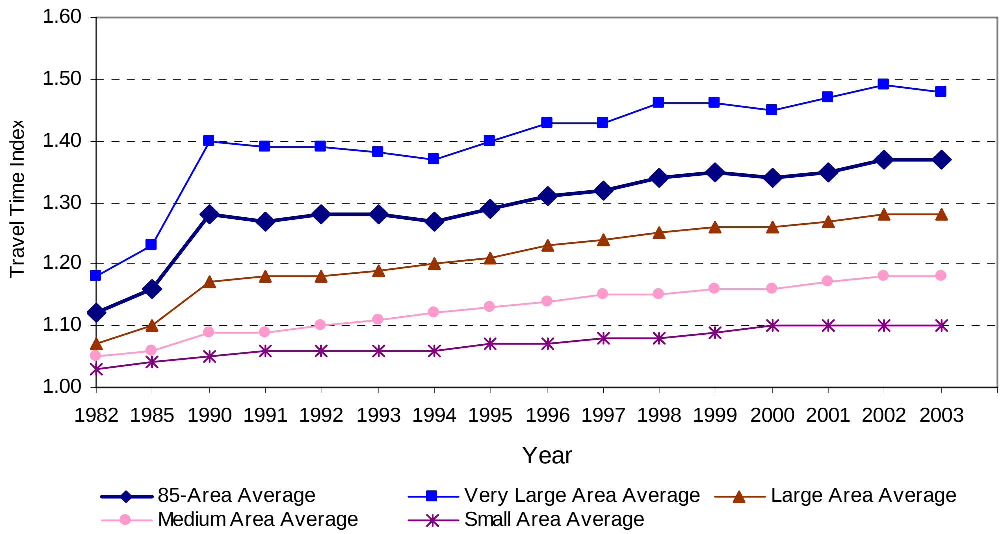

Exhibit 2-10: Travel time index[11]

[10] Note: The roadway congestion index (RCI) is a measure of vehicle travel density on major roadways in an urban area. An RCI exceeding 1.0 indicates an undesirable congestion level, on average, on the freeways and principal arterial street systems during the peak period. The urban areas included are those containing over 500,000 people and several smaller places mostly chosen by previous sponsors of the Texas Transportation Institute study on mobility. Source: Department of Transportation, *National Transportation Statistics 2005*.

[11] Note: The travel time index (TTI) is the ratio of peak-period travel time to free-flow travel time. The TTI expresses the average amount of extra time it takes to travel in the peak relative to free-flow travel. A TTI of 1.3, for example, indicates a 20-minute, free-flow trip will take 26 minutes during the peak travel time periods, a 6-minute (30 percent) travel time penalty. Source: Department of Transportation, *National Transportation Statistics 2005*.

Increases in demand for transportation services, continuing increases in highway usage intensity, worsening roadway congestion, increases in travel times, and limited resources for investment in highway maintenance and improvement together pose great challenges for transportation agencies. Considering economically justified investment, projected spending requirements are far above the levels of current spending on highway maintenance and improvement. The gap between projected investment requirements and current spending is very large in the future (Exhibit 2-11). From 2001 to 2020, just to maintain highways and bridges would require annual spending to be 17.5 percent higher than current levels of spending, and to improve highways and bridges would require an annual investment that is 65.3 percent higher than current annual spending.

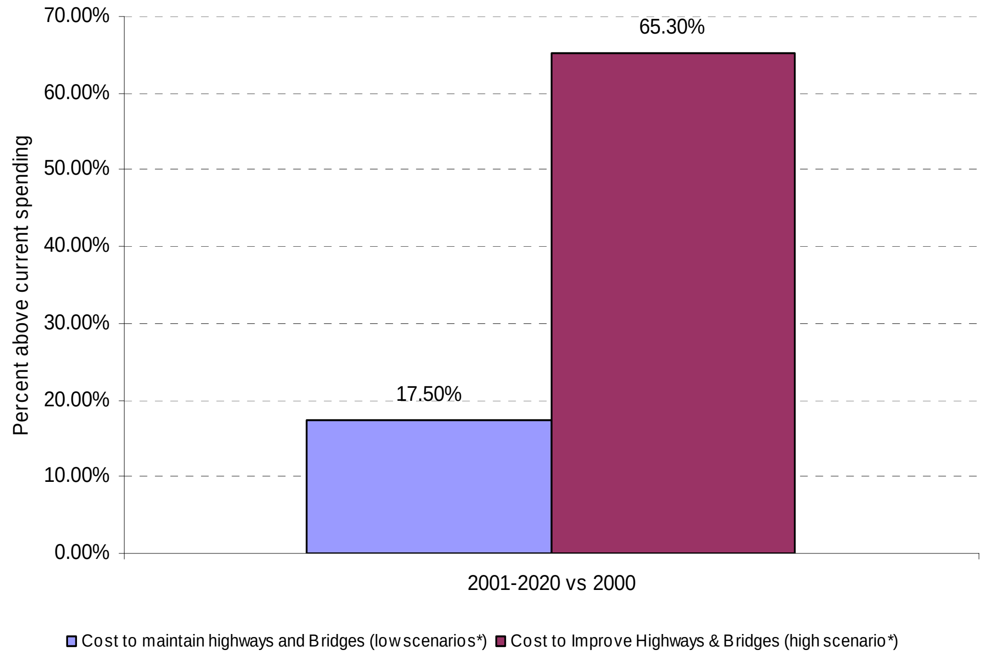

Exhibit 2-11: Projected investment requirements versus current spending[12]

2.4 Summary

This study is focused on how state DOTs are managing their assets in recognition of the expected significant growth of VMT and truck freight movements over the next two decades. The asset management practices of four state DOTs are documented here, including how they manage their financial and infrastructure resources to address and plan for the projected increases in demand on their transportation system. Examples of good asset management practices are included to demonstrate how state DOTs are setting priorities to address capacity and deterioration deficiencies resulting from the expected substantial increases in demand and aging facilities.

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12 Federal Highway Administration: *2002 Status of the Nations' Highways, Bridges, and Transit: Conditions & Performance.*

Chapter 3. Study Objectives and Approach

3.1 Introduction

Chapter 2 described the movement to adopt TAM within state DOTs and recent trends in U.S. highway travel demand growth. Given that background, this chapter describes the specific questions addressed by this study and the approach taken in evaluating how a sample of four state DOTs are applying TAM principles to the issue of continued growth in travel demand. This chapter also describes the process used to identify the four sample states selected for this project and provides a brief analysis of the varied highway network and travel demand characteristics of each of these states.

3.2 Study Objectives

This study seeks to determine whether and how state DOTs are using TAM and related techniques to address the issue of existing and anticipated future travel demand. Correspondingly, this study attempts to identify and document *all* cases in which state DOTs have incorporated travel demand measures within TAM and related analyses and decision-making processes. This includes those instances in which current and projected travel demand measures are used as *inputs* to TAM processes as well as those instances where a mitigated travel demand-related problem is the intended *output* of a TAM process (see Exhibit 3-1).

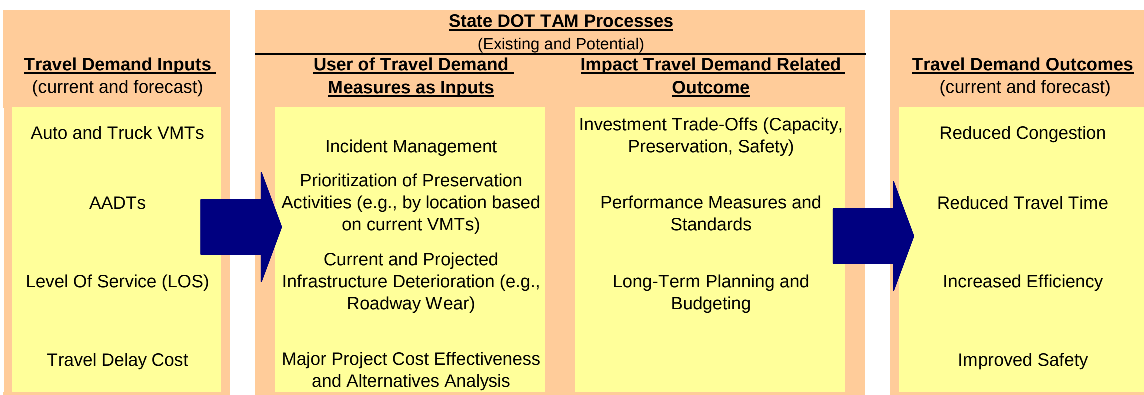


Exhibit 3-1: Travel demand as inputs to and outputs of TAM processes

At a minimum, the study set out to determine how state DOTs are addressing the following issues:

Current and projected travel demand measures as inputs to the TAM process

1. **Infrastructure deterioration (e.g., roadway wear):** Increasing traffic volumes and vehicle weights result in increasing rates of roadway deterioration. How do state DOTs take current and projected travel demand measures into account when evaluating the *current* maintenance and rehabilitation needs of existing roadway infrastructure? Are state DOTs using current and/or projected travel demand measures to help *project* the timing and magnitude of future rehabilitation and replacement needs?

2. **Investment prioritization:** The benefits of reinvesting in existing infrastructure tend to be highest for segments with relatively greater customer utilization. How are state DOTs using TAM and related techniques to prioritize roadway re-investment between and within regions based on current and projected future utilization?

3. **Project benefit-cost and alternatives analysis:** The cost-effectiveness (or return on investment) of major new investments and the relative benefits of project alternatives are heavily influenced by travel-time savings. How are state DOTs incorporating travel-time savings into their selection processes for major projects?

Using the TAM process to address issues related to travel demand

4. **Capacity improvements:** As noted above, the rate of growth in travel demand remains well above the rate of growth in roadway capacity, leading to increasing congestion and travel times. Have state DOTs adopted TAM-related practices to help identify capacity improvement strategies or for prioritizing potential expansion investments?

5. **Safety improvements:** Increasing roadway utilization also brings increasing opportunities for crashes, injuries, and fatalities. How are the safety implications of current and future travel demand for both light- and heavy-duty vehicle traffic factored into system management decisions?

6. **Trade-offs between preservation and capacity needs:** All state DOTs face the problem of balancing re-investment in existing roadway capacity with the need for additional capacity to address growing demand—all within limited financial resources. How have TAM and related processes been used to allocate funds between these and other competing needs, and how do travel demand measures inform this allocation?

7. **Objectives and performance measures:** TAM emphasizes the need to establish long-term system objectives and to develop processes and measures to evaluate success in attaining those objectives. How do state DOTs propose to measure and report performance relative to travel demand? Have they identified or established desired performance standards with respect to roadway volumes, congestion, and other travel demand-related measures? If not, why?

8. **Long-term planning and budgeting:** TAM emphasizes the need to take a long-term, strategic view in establishing attainable organizational objectives within realistic resource constraints. Given these objectives, how do state DOTs incorporate travel demand forecasts into their long-term investment plans? How are those plans constrained by existing resources? How are long-term travel demand and budgeting concerns incorporated into agencies' strategic plans? How long is the long-term?

3.3 Study Approach and Sample States

The study collected data on the asset management, travel demand forecasting, and related practices of four state DOTs: California (Caltrans), Michigan (MDOT), North Carolina (NCDOT), and Utah (UDOT). The study team conducted two to three full days of interviews with key staff at each agency, including asset managers, travel demand modelers, short- and long-range planning staff, short- and long-range programming and budgeting staff, roadway maintenance staff, operations personnel, and IT and database maintenance staff. Interviews were intended to fully document the following:

1. The extent and maturity of each state's asset management program
   - Structure and role within broader DOT organization
   - Program goals and objectives
   - History and development
   - Capabilities
   - Future plans
   - Dedicated resources

2. How DOTs use TAM to address travel demand issues
   - Collection of current and projected travel demand measures
   - Uses of travel demand measures in support of asset management
   - Intermodal, interstate, and international traffic flow considerations
   - Current operations and maintenance

3. How DOTs address their long-term investment needs
   - Long-term transportation planning
   - Long-term budgeting
   - Strategic transportation planning (how does asset management inform or shape each state's infrastructure and financial plans?)

The sample states were selected to provide a broad representation of highway network features, travel-demand characteristics, system size, population growth, urban concentration, industry, climate, and topology. States were also selected to include some of the more advanced in the adoption of TAM practices.

The selected states of California, Michigan, North Carolina, and Utah provide a broad cross-section of state highway and travel-demand characteristics nationwide. For example, this group of states encompasses a wide range of state-maintained highway networks (NCDOT is responsible for close to 170,000 lane-miles versus just 15,000 for UDOT), varying shares of urban versus rural roadways (25 percent of Caltrans-maintained highways are urban versus just 12 percent for NCDOT), a range of population and VMT growth rates (urban annual VMT growth is just over 2 percent in California and Michigan but exceeds 3 percent in Utah and North Carolina), and wide variations in congestion (urban AADT per lane mile exceeds 17,000 in California but is only 4,000 in North Carolina).

3.3.1 Asset Management Plan Development

In addition to including states considered among the more advanced in adopting TAM practices, the selected states have also emphasized varying practices. For example, Michigan is the most advanced in data collection and dissemination, Utah has emphasized the development of decision-support tools, and California is focused on the development of state-wide performance monitoring. North Carolina has placed less emphasis on specific goals (and hence, has less capabilities than some other states in specific areas) but more effort on embracing a more comprehensive asset management approach.

Although each of these states has made strong progress in adopting specific asset management practices, none has fully implemented a program that encompasses *all* TAM functions as outlined earlier in Exhibit 2-1 (i.e., including well-defined program goals and polices; comprehensive asset inventory; decision-support tools; comprehensive long-range *strategic* planning and budgeting; and *full* program optimization across all asset types, regions, and investment types). Rather, each of these state DOTs is working towards development of comprehensive TAM programs and the further refinement of its existing processes. Moreover, the development of their existing programs clearly represents many years of sustained investment, and the successful implementation of new improvements will similarly require considerable effort. The evidence from this study suggests that these investments are clearly paying off in the form of better data, credible analyses, and more informed decision making.

3.4 Characteristics of the Participant States

Exhibit 3-2 presents the characteristics of each of the states participating in the study: California, Michigan, North Carolina, and Utah. Brief descriptions follow.

Exhibit 3-2: Demographic, roadway, and travel-demand characteristics of sample states (2004)

State	California	Michigan	North Carolina	Utah
General Characteristics				
Population (Millions)	34.7	10.1	8.0	2.2
Projected Annual Population Growth	1.3%	0.5%	1.5%	1.8%
Area (Sq Miles)	163,707	96,810	53,821	84,904
Population Density (pop per sq mile)	212	104	149	26
Gross State Product ($Billions)	$1,359	$321	$276	$70
Roadway Miles: Total	169,793	122,381	102,666	42,712
Mean Travel Time to Work (Minutes)	27.7	24.1	24.0	21.3
State Controlled Roadways: Infrastructure				
Roadway Miles	15,209	9,720	78,871	5,858
State Controlled Share of Total Roadway Miles	9.0%	7.9%	76.8%	13.7%
Lane Miles	50,522	27,578	168,029	15,260
Annual Growth in Lane Miles	0.2%	0.3%	0.3%	0.3%
Lane Miles Per Roadway Mile	3.32	2.84	2.13	2.60
Urban Share of Total Lane Miles	42%	39%	14%	25%
Bridges	24,007	10,879	17,509	2,815
State Controlled Roadways: Expenditures				
Capital Outlays ($M)	$4,130	$1,095	$1,834	$451
Maintenance and Services ($M)	$708	$245	$570	$107
Expenditures per Lane Mile ($000)	$95.8	$48.6	$14.3	$36.6
State Controlled Roadways: Travel Demand				
Daily VMT (in thousands)	502,858	159,951	227,536	47,575
Annual Growth in Daily VMT (1994 to 2004)	2.5%	2.8%	2.9%	3.0%
AADT per Lane	9,953	5,800	1,354	3,118
Annual Growth in AADT per Lane (1994 to 2004)	2.2%	2.2%	2.6%	2.7%

3.4.1 California

California's geography is perhaps the most diverse of all 50 states. In addition to a mountainous perimeter and Central Valley dominated by a fertile plain, California also features more than 800 miles of ocean coastline and several of the nation's largest urban areas. The state also experiences widely divergent climate including from desert in the south, rain forest along the northern coasts, and high alpine terrain on its eastern boarder.

California is also an economic powerhouse. With a gross state product of more than $1.4 trillion annually, California produces more than 13 percent of the nation's total goods and services and is frequently touted as the world's sixth largest economy. The state is also home to several large ports, including those in Los Angeles/Long Beach and Oakland, which directly support international trade flows between Asia and the 48 contiguous states. The state is also a major provider of fresh produce to the rest of the nation. With more than 34 million people, California is the nation's most populous state. Population is projected to grow at an average annual rate of 1.3 percent over the next 20 years.

With over 169,000 miles of roadway and more than 24,000 bridges, California is home to the nation's second largest roadway network (after Texas). Maintenance, preservation, and expansion of this large network pose special problems and conflicting demands on state resources ranging from high traffic demand in multiple urban areas to heavy snow removal requirements in mountainous regions. This network is also characterized by one of the nation's largest concentrations of lane miles in urban areas and a very high proportion of multi-lane highways relative to other states.

The problem of traffic congestion on California's urban highways is well documented and projected to worsen in the future given ongoing increases in population and economic development. Mitigation of this problem is a special challenge given the maturity of the state's existing urban roadway networks. One consequence of the state's urban congestion is ongoing urban expansion and the development of previously rural areas.

3.4.2 Michigan

The Great Lakes divide Michigan into two large peninsulas, both located north of the nation's major east-west transportation corridors. Michigan's economic success depends on a sound multimodal transportation system to provide access for people and goods both to the rest of the nation and across the border into Canada.

Michigan has over 120,000 miles of statewide highways and more than 11,000 bridges. A significant challenge facing MDOT is Michigan's unusual climate. The lakes modify the severe northern winter weather, leading to heavy lake effect snows and frequent freeze-thaw cycles. The results are rapid infrastructure deterioration, high maintenance costs, and a small window for road construction activities. Under these conditions, investments that extend the life of existing facilities and improve the performance of the transportation system are essential for Michigan's citizens and economic sector to prosper. MDOT's asset management process focuses on these objectives.

Michigan is currently home to more than 10 million people, and the state's population is expected to grow at an average annual rate of 0.5 percent through 2025. While Michigan has the lowest rate of population growth among the four sample states, it continues to experience strong VMT growth, particularly in the state's urban areas. With modest expansion in the existing roadway network, this ongoing growth in travel demand is also yielding related increases in congestion, travel delays, and lost productivity, most notably in the urbanized areas surrounding Detroit.

3.4.3 North Carolina

North Carolina's geography is representative of the nation's Mid-Atlantic states, including a mountainous west, a rolling piedmont mid-section, and a flat coastal plain in the east. While the state's climate is considered mild relative to the many extremes within the U.S., the state is subject to long, hot summers, which accelerate the process of asphalt drying and deterioration.

North Carolina's economy has undergone extensive growth in recent years, moving beyond the state's traditional industries, such as tourism and agriculture, to embrace higher-paying, service-sector employment relating to banking and the region's growing research centers. North Carolina's gross state product is roughly $270 billion annually. The state is currently home to 8 million people, and its population is expected to grow at a robust 1.5 percent average annual rate through 2025.

North Carolina has over 100,000 miles of statewide highways and more than 17,000 bridges. In stark contrast to the other states included in this study, the state's department of transportation, NCDOT, is responsible for the maintenance and operation of more than 75 percent of the state's roadway network and bridges (versus an average of roughly 10 percent for the other study states). Responsibility for such a large share of the state's aging highway network places unusually high demands on NCDOT's highway resources. Also in contrast to the other study states, North Carolina's highway network continues to expand by more than 400 miles per year due to: (1) a legislative requirement to build out the state's intrastate highway network, (2) continued paving of rural dirt roads, and (3) NCDOT's responsibility to maintain roads constructed for housing developments located outside of municipal boundaries. These growing challenges are central to the department's strong interest in the initial development and ongoing improvement of its asset management program.

While the state's traffic congestion problems may be considered minor relative to those of California or even Michigan, these issues will become more significant if not addressed in the near term. As already noted, North Carolina continues to experience strong population growth. Moreover, the state's rate of growth in VMTs and AADT per lane is also larger than that experienced by either California or Michigan (although smaller than Utah's).

3.4.4 Utah

Utah's geography is unique within the sample of states in this study in that it does not border any major bodies of water or reside on an international border or international waterway. Rather, Utah is "land-locked" and centrally located. Consequently, much of the traffic on interstate highways flows through the state (rather than originating and/or terminating within the state as with California, Michigan, and, to a lesser extent, North Carolina). The state also features a broad range of terrains including high mountain ranges, salt flats, and a rugged desert. These extremes in elevation and terrain also bring wide variation in temperature and snowfall.

Of the four states included in this study, Utah has the smallest economy (an annual gross state product of $70 billion), the smallest population (2.2 million), and by far the lowest population density (26 per square mile versus 212 for California, 104 for Michigan, and 149 for North Carolina). The vast majority of the state's population, economic activity, and growth is located along the western boundary of the Wasatch Front stretching between Ogden, Salt Lake City, and Provo. Within this corridor, population densities and the resulting congestion are comparable to the nation's other urbanized areas. Moreover, with projected average annual population growth of 1.8 percent (the highest of the sample states) and the confining influences of mountains on the east and Salt Lake and Provo Lake to the west, population densities and travel demand within this corridor are expected to continue growing. Over the period from 1994 through 2004, Utah's state-maintained highways exhibited the fastest overall rates of growth in both VMT and AADT per lane among the four states included in this study.

With only 43,000 miles of statewide highways, Utah has the smallest public roads network of the four study states. UDOT is responsible for operation and maintenance of just under 6,000 miles of road and fewer than 3,000 bridges. With the state's population and economic activity centered on the Salt Lake City region, very low population densities in the rest of the state, and wide variations in climate, UDOT faces unique challenges when attempting to prioritize capital investments and maintenance resources within and across regions. A key motivation in adopting asset management practices was to determine how best to allocate transportation resources both optimally and equitably.

3.5 Comparative Analysis of State DOT-Operated Highways

Exhibit 3-2 provides a range of statistics comparing the economic, geographic, demographic, highway network, and travel demand characteristics of the four sample states. This sub-section considers several of these measures in greater detail, with emphasis on the relative levels and rates of growth in network size and travel demand on state-controlled highways (i.e., the network that state DOTs control).

Exhibit 3-3 compares the total number of lane-miles within each of the four sample states as well as the share of those lane-miles that are owned and maintained by the state DOT. Although California has the largest highway network, with close to 380,000 lane miles statewide, North Carolina has by far the largest number of state-maintained highways (both as a proportion of statewide miles and in total lane-miles maintained). The high share of state-maintained lane-miles within North Carolina places high demands on the state's highway resources (with more highway miles to maintain per dollar of funding) and has also required a closer working relationship between the state and local governments than is the case in other states (i.e., to manage and prioritize preservation and expansion projects).

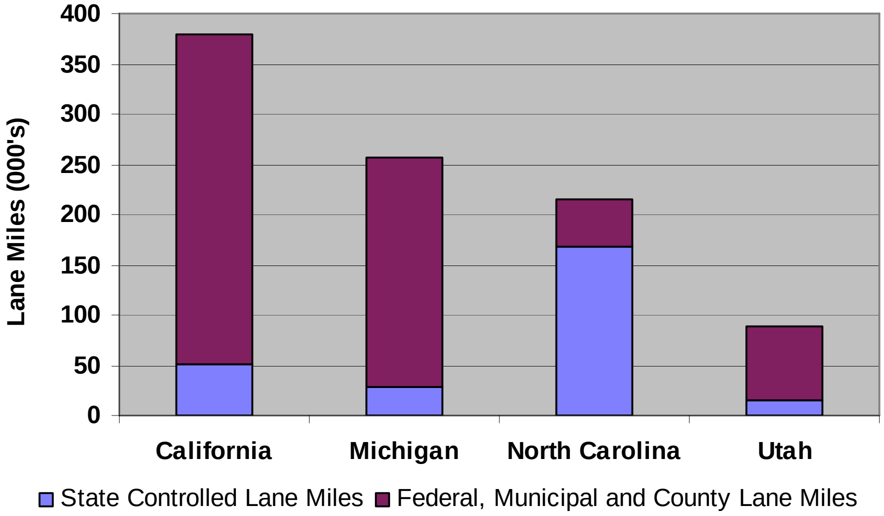


Exhibit 3-3: Total lane-miles statewide in sample states

Exhibit 3-4 presents the number of state-controlled lane-miles operated by each of the four sample states over the period 1994 to 2004. As with the national trends depicted in Chapter 2, the number of state-controlled lane-miles within each of these four states has grown very slowly over the past decade, averaging roughly 0.2 percent to 0.3 percent annually for each of the four states. However, given its large existing highway network, small percentage increases in North Carolina's network translate into significant investment in new lane-miles relative to the other study states. This situation is apparent in Exhibit 3-5, which shows that North Carolina's roadway network increased by close to 450 miles each year over the last decade. This rate of increase was more than 3 times that of California, more than 5 times that of Michigan, and more than 10 times that of Utah.

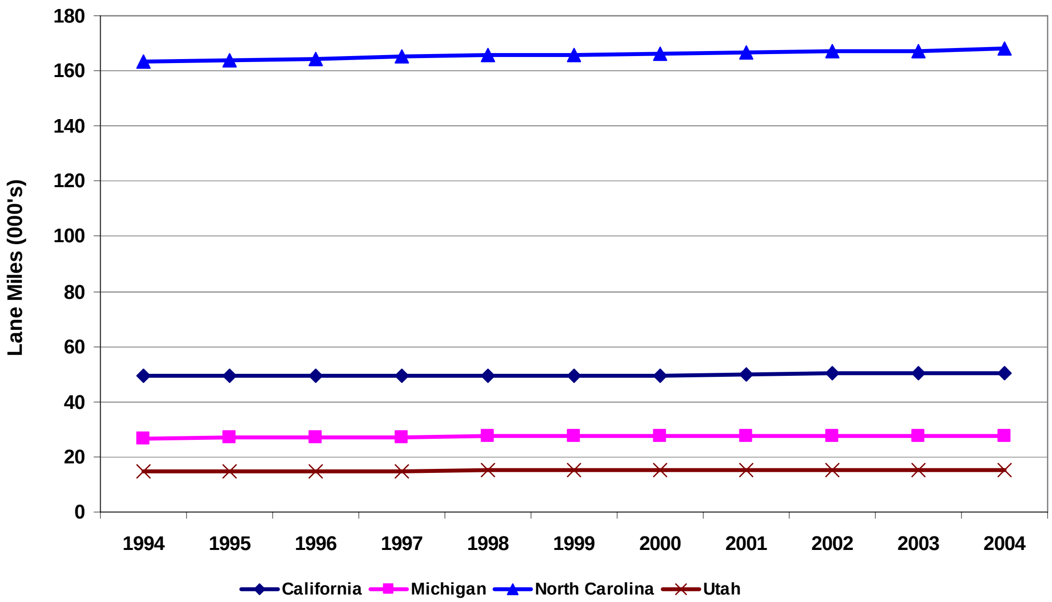


Exhibit 3-4: State-controlled lane-miles in sample states

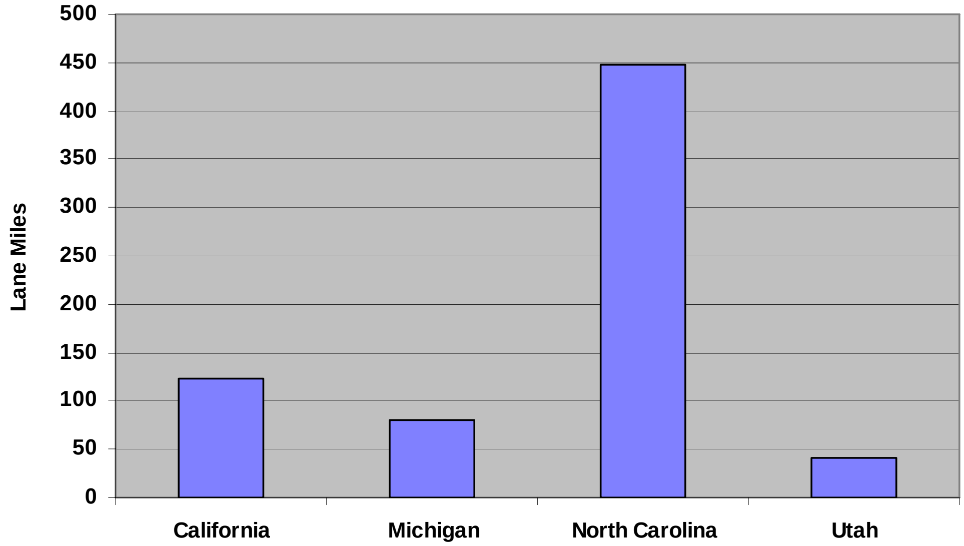


Exhibit 3-5: Average annual increase in state-controlled lane-miles

Exhibit 3-6 presents the proportion of state-controlled lane-miles within each of the four sample states that are located in urban areas. Of the four states, California maintains by far the highest number of urban highways as a share of total state-maintained highways. California, Michigan, and Utah have each experienced slow, long-term increases in the proportion of state-maintained urban highways (the recent jump in shares for Michigan and Utah reflect recent reporting changes due to the 2000 Census). By contrast, North Carolina's state-controlled highways are clearly dominated by rural roadways and the state's share of urban roadways remains flat, due most likely to state control of local roads in non-urban areas.

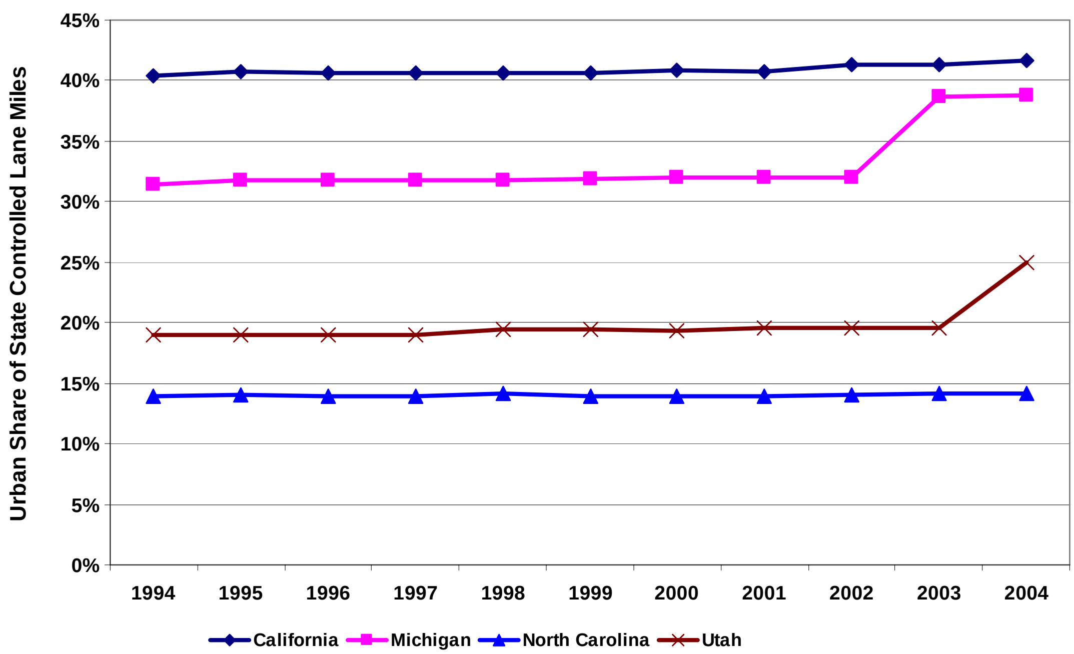


Exhibit 3-6: Percentage of state-controlled highways located in urban areas

The characterization of each state's highways into urban and rural types is important to this study. Travel demand-related issues of traffic congestion, increasing travel times, and lost productivity are primarily urban issues; therefore, any state efforts to monitor and mitigate these issues will necessarily be focused on urban areas.

Exhibit 3-7 documents the levels and rates of increase in daily VMTs on state-controlled highways within the four sample states over the past decade. California's state-maintained highways carry significantly more traffic as compared to the three other states. Moreover, while each of the four states experienced an annual growth rate in daily VMTs of between 2.5 percent and 3.0 percent over the period 1994 to 2004, California's state-maintained roads have clearly experienced the largest annual increase in the number of VMTs. Specifically, over the last decade, the average annual change in daily VMTs for California was 10.9 million. Comparative figures elsewhere include annual increases of 5.6 million for North Carolina, 3.5 million for Michigan, and 1.2 million for Utah. The large number of VMTs and significant growth in VMTs for North Carolina reflect the large number of state-controlled lane-miles in that state.

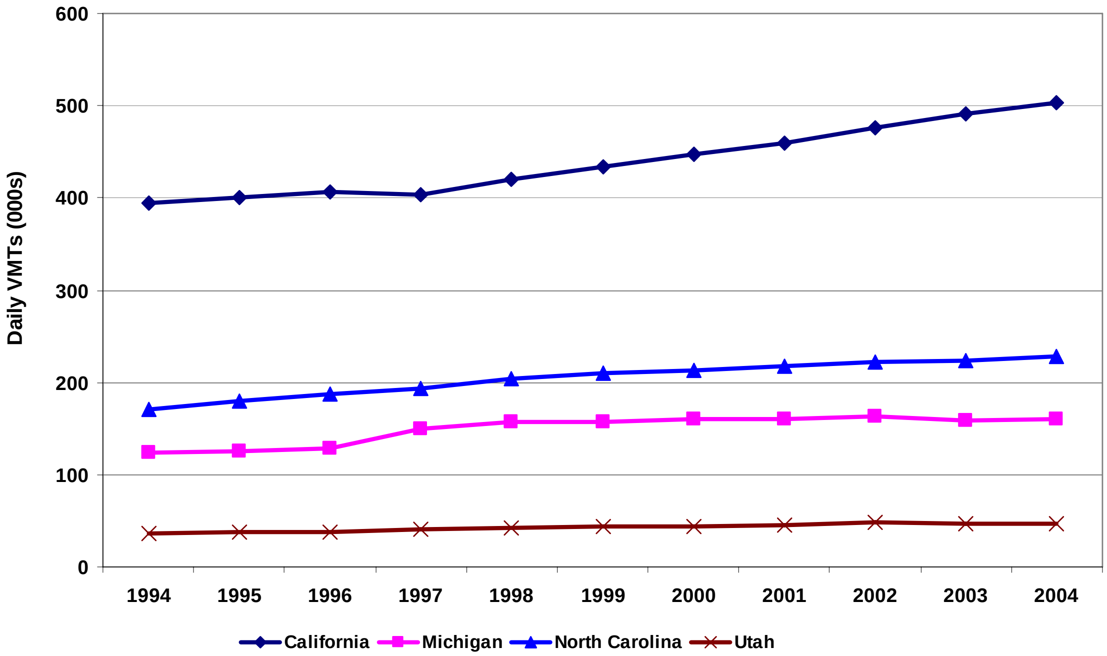


Exhibit 3-7: Daily VMT on state-controlled highways

Exhibit 3-8 documents the levels and rates of increase in AADT per lane on state-controlled highways within the four sample states over the past decade. In effect, Exhibit 3-8 normalizes the daily VMT measures presented in Exhibit 3-7 to reflect the wide differences in total state-maintained lane-miles within each state and the widely varying implications for roadway utilization, traffic congestion, roadway deterioration, and safety.

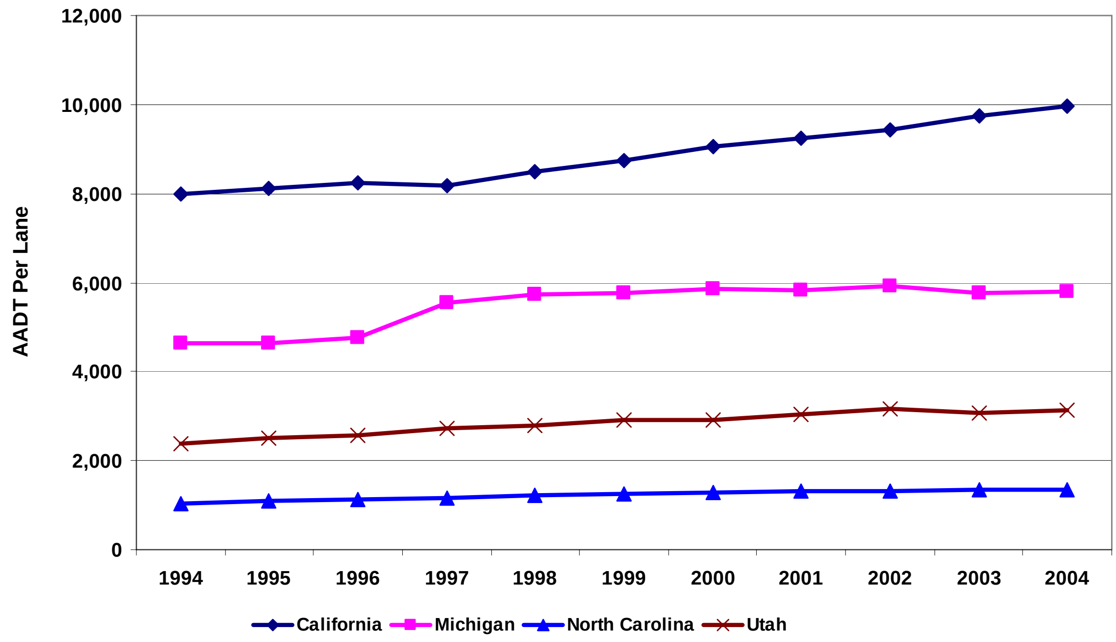


Exhibit 3-8: AADT per lane on state-controlled highways

Exhibit 3-8 demonstrates that lane-mile utilization is significantly higher in California than the other three states. However, regardless of differences in existing AADT per lane values across these four states, the *annual rate of increase* in AADT per lane is well over 2 percent for each state (2.2 percent for California and Michigan, 2.6 percent for North Carolina, and 2.7 percent for Utah), reflecting the increasing divergence between growth in travel demand and lack of growth in physical capacity. Over the period 1994 to 2004, the *average annual increase in AADT per lane* was highest for California and Michigan (at 196 and 115 vehicles per day, respectively) and lowest for Utah and North Carolina (at 73 and 31 vehicles per day, respectively).

Exhibit 3-9 segments the AADT per lane data from Exhibit 3-8 into their urban and rural components. Aside from highlighting the significantly higher level of highway utilization in urban versus rural areas, this exhibit also demonstrates the relatively low level of utilization for North Carolina's highway network (e.g., where urban AADT per lane is comparable to rural roadway utilization in California and Michigan).

Exhibit 3-9 summarizes the differences between the historic rates of growth in lane-miles, VMTs, and AADT per lane for all four states. This exhibit also further segments these rates into their urban and rural components. Once again, this presentation emphasizes the low rate of growth in lane-miles relative to the more rapid increase in travel demand (as measured by VMT), yielding an overall increase in highway utilization (as measured by AADT per lane). Interestingly, while the rate of increase in VMTs has been higher in urban areas, rural areas have experienced higher rates of growth in AADT (with the exception of North Carolina). This trend may reflect ongoing suburban expansion or "sprawl" beyond traditional urban boundaries.

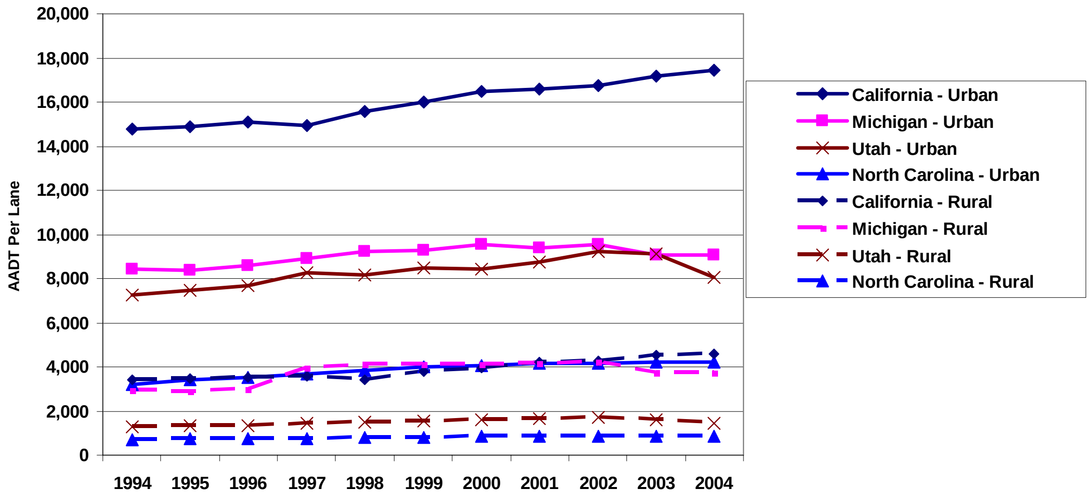


Exhibit 3-9: AADT per lane on urban versus rural state-controlled highways

Several of the preceding exhibits have emphasized variations in the current levels and rates and growth in roadway utilization across the four sample states, particularly in urban areas. As may be expected, these variations translate into varying levels of congestion and travel delay costs. Exhibit 3-11 provides estimates of the total annual hours of travel delay for select urban areas located within each of the four sample states (based on analysis from the Texas Transportation Institute's *2005 Urban Mobility Report*). It is important to note that this analysis is not inclusive of all urban areas within each state. Moreover, the analysis measures travel delay across *all* highways and not just those maintained by the state DOTs. Nevertheless, this travel delay analysis does accurately depict the congestion issues faced by each state DOT within its state's urban areas. For example, Exhibit 3-11 makes it clear that California must address congestion delay issues of greater magnitude (particularly in the region surrounding Los Angeles) and in more urban areas than any of the other four study states.

Exhibit 3-10: Rate of growth in lane-miles and travel demand, 1994-2004

	California	Michigan	North Carolina	Utah
Lane Miles				
Urban	0.6%	0.6%	0.4%	0.6%
Rural	0.0%	0.2%	0.2%	0.1%
All	0.2%	0.3%	0.3%	0.3%
VMTs				
Urban	2.3%	3.5%	3.2%	3.2%
Rural	3.1%	1.8%	2.6%	3.0%
All	2.5%	2.8%	2.9%	3.0%
AADT per Lane				
Urban	1.7%	1.6%	2.8%	2.6%
Rural	3.1%	2.5%	2.4%	2.8%
All	2.2%	2.2%	2.6%	2.7%

While Exhibit 3-11 captures the total travel delay within each urban area (reflecting both the average delay time for each traveler and the number of travelers), Exhibit 3-12 depicts the estimated travel delay on a per-traveler basis. This exhibit also highlights the greater magnitude of California's traffic congestion issues statewide, and effectively demonstrates the high cost of traffic congestion to individual travelers within each of the four sample states.

Although congestion is primarily a function of the number of vehicles on the road, infrastructure deterioration is primarily a function of the composition of those vehicles, with truck traffic contributing most to the rate of pavement wear. Exhibit 3-13 presents truck traffic as a share of total VMTs for urban and rural highways in each of the four sample states as well as for the nation as a whole. This exhibit demonstrates that while urban truck traffic represents a relatively consistent share of total VMTs across each state, there is significantly greater variation in trucks' share of rural VMTs. In particular, trucks account for a very high proportion of rural VMTs in Utah, reflecting both the low rural population densities and the large volume of truck traffic flowing *through* the state.

This comparative analysis has focused on the characteristics of the roadway networks, travel demand, and congestion of the four sample states. By contrast, Exhibit 3-14 compares the levels of capital, maintenance, and operations expenditures on state-maintained roadways within each sample state. Based on 2004 data, California expends more total funds on roadway operations, maintenance, and capital outlays, while Utah spends the least. When expressed on a per-lane-mile basis, California spends roughly $95.8 thousand per lane-mile on these activities, while North Carolina, with its very large state-maintained highway network, spends a more modest $14.3 thousand per lane mile. Michigan and Utah fall between these two points, spending $48.6 thousand and $36.6 thousand per lane-mile, respectively.

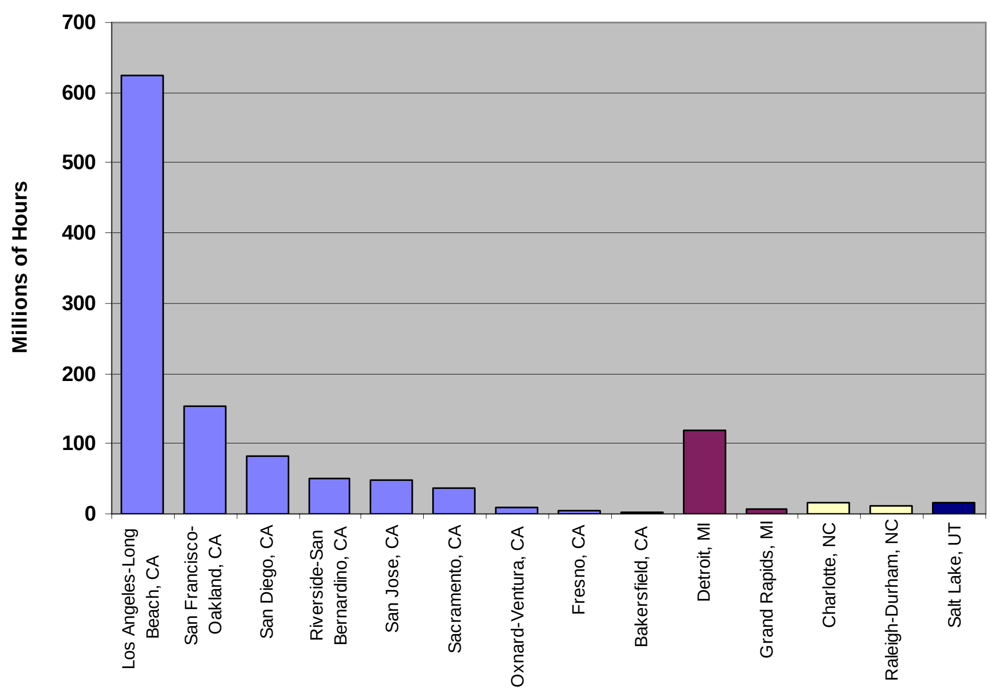


Exhibit 3-11: Total annual travel delay in sample state urban areas

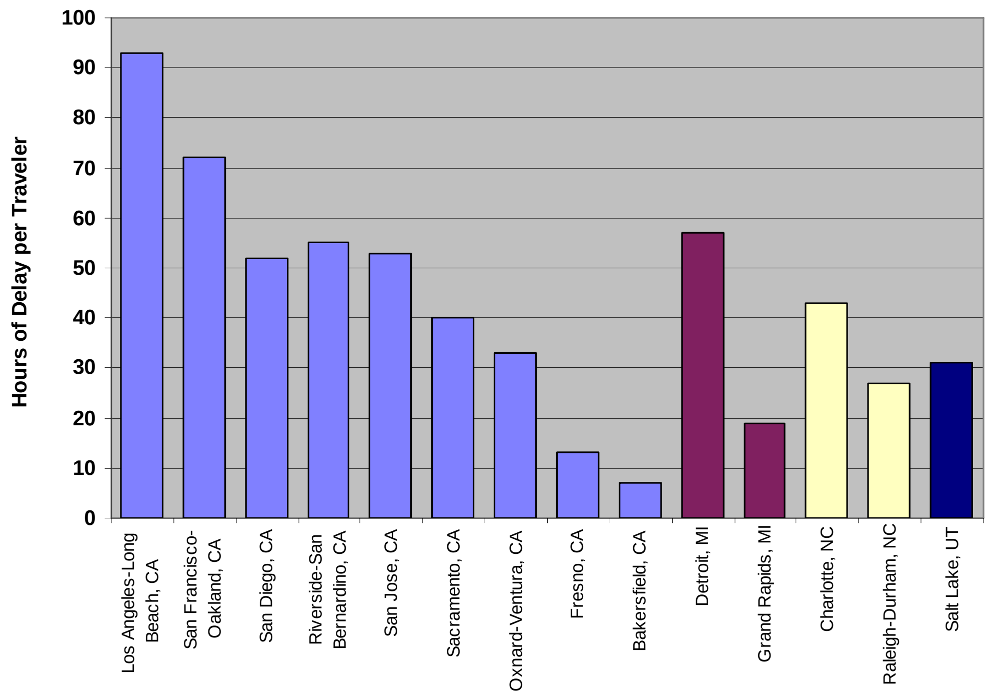


Exhibit 3-12: Annual delay per traveler in sample state urban areas

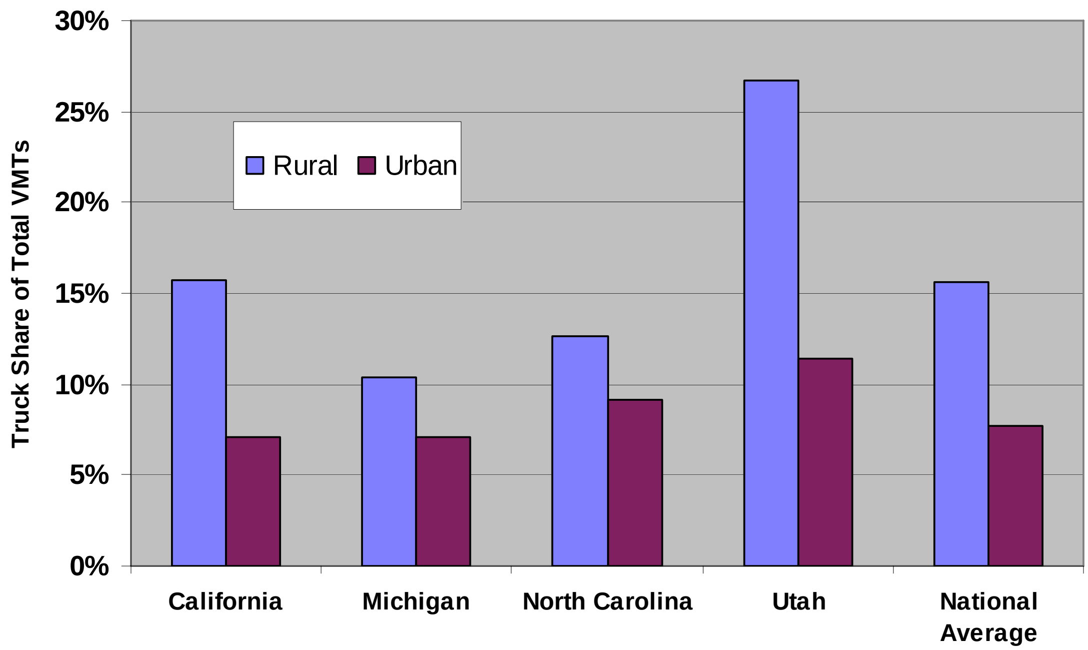


Exhibit 3-13: Truck traffic as a share of statewide VMTs

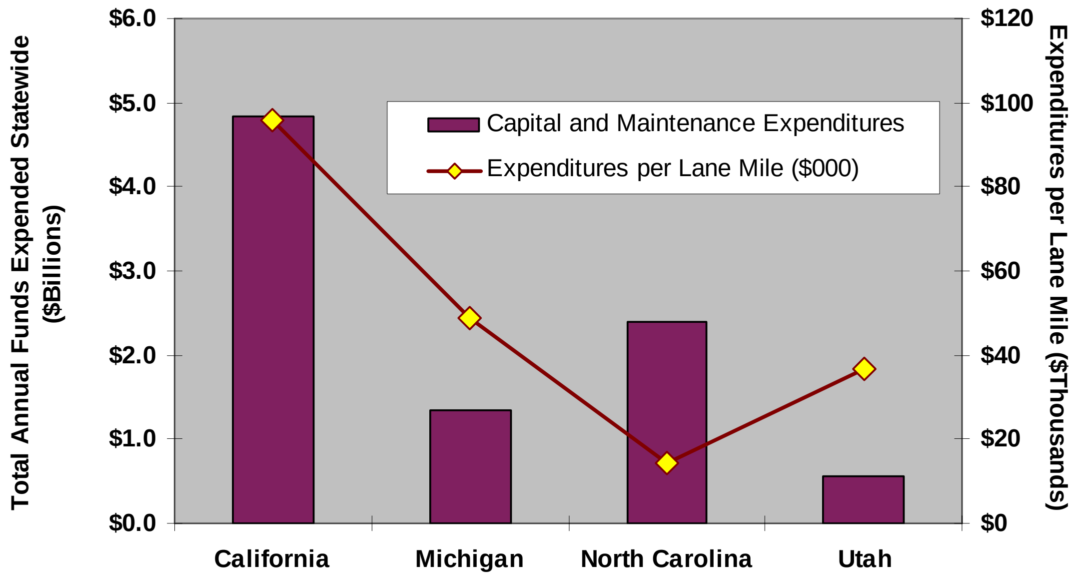


Exhibit 3-14: Capital and maintenance expenditures from federal, state and local sources (2004)

Chapter 4. Assessment of Four State DOTs' Use of Asset Management to Address Travel Demand Growth

4.1 Approach

This chapter provides a detailed review of how the four state DOTs participating in this study are currently utilizing TAM practices to address issues relating to existing and anticipated future growth in travel demand. The review is based on data collected during two- to three-day site visits at the DOT headquarters of each state between March and June 2006. The interview guide used during these on-site visits is reproduced in Appendix A. Subsequent appendices provide state DOT responses to a survey completed prior to each site visit.

The chapter describes the following, organized by state according to the order in which the interviews were conducted:

- Organizational structure of the state DOT
- Major components of TAM programs
- Travel demand measurement and forecasting capabilities
- Links between TAM and travel demand measures

Following are brief descriptions of the understanding sought for each of these characteristics.

4.1.1 Organizational Structure of the State DOT

Reviews of state DOT organization charts provided a basic understanding of the roles, responsibilities, and structure of each participant agency. These reviews also helped to identify those agency divisions with asset management, travel demand measurement, or travel demand forecasting responsibilities and the interrelationships among these and other divisions that consume TAM and/or travel demand data. These reviews were also helpful in identifying each DOT's relationships with those outside bodies that provide decision-making authority for large transportation investments (e.g., the Transportation Board or Commission).

4.1.2 Major Components of TAM Programs

In exploring the links between TAM and travel demand, this study employs the American Association of State Highway and Transportation Officials' (AASHTO's) current definition of TAM, as established at the January 2006 meeting of AASHTO's Subcommittee on Asset Management:

> Transportation Asset Management is a strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively through their life cycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision-making based upon quality information and well-defined objectives.

The interview and analysis process study was designed to document each of the primary asset management techniques and processes as encompassed by this broad definition. These include the following:

TAM program focus

The relative strengths, weaknesses, and primary focus of each state DOT's TAM program reflects its historical development as well as the particular needs, legislative environment, funding capacity, and "color-of-money" limitations within each state. Given these considerations, a key objective of this study was to determine the primary focus and priorities of each state's existing asset management program. The assessment below demonstrates that many TAM programs remain focused on traditional asset management practices (e.g., pavement and bridge management) with a heavy emphasis on system preservation. It also shows that, at this time, most TAM programs make only modest use of travel demand measures for the following two reasons:

- Agencies have not developed models that incorporate infrastructure utilization (e.g., VMTs) in their preservation needs analyses.
- Current TAM programs are preservation focused while travel demand growth issues are typically best addressed by capacity expansion and operational improvement investments.

Goals, objectives, and performance measures

Goals, objectives, and performance measures provide transportation agencies with strategic direction and ongoing performance evaluation. The specific goals and objectives selected either for the DOT as a whole (broad) or for the TAM program in particular (narrower) typically reflect the agency's primary concerns and those issues of highest priority. A review of these goals and objectives can quickly reveal the relative importance placed on travel demand-related issues (e.g., mobility and congestion) within the broader scope of issues facing each DOT. As shown below, travel demand issues are not typically addressed by the state's TAM program goals, but are typically considered in the broader, agency-wide goals.

"Baseline" asset management tools

Most state DOTs have implemented basic asset management practices in the form of "traditional" pavement, bridge, and maintenance management systems. Documentation of the existence and use of these traditional systems provides a crude baseline measure of the maturity of each state's TAM program.

Data collection and distribution

The collection and dissemination of quality asset management and travel demand data remains a cornerstone of effective asset management. Stated differently, effective decision-making relies on quality information which, in turn, relies on the availability of high-quality data. Moreover, the inclusion of travel demand measures in asset management analyses requires links between those databases housing the appropriate asset management data (e.g., asset inventory and physical condition) and those housing the corresponding travel demand measures (e.g., vehicle counts and VMT forecasts) for the same network segments. This review considers what asset management data the agencies are collecting (including travel demand data) and how these data are made available to potential users within the state DOT.

The most commonly collected data are infrastructure inventories for pavement, bridges, tunnels, vehicles, and real estate; asset age, condition, maintenance history, and related data; projections of future asset conditions using forecasting tools; current travel demands as measured by traffic counts; and future travel demands creating using forecasting tools. These data are required to support each state's pavement, bridge, and maintenance management systems; travel demand models; and other management systems for assets. Using some or all of these data, DOTs can evaluate current asset conditions, forecast future conditions, evaluate combinations of fixes, and determine short- and long-term investment needs related to preservation, safety, operations, and capacity.

Investment decision making processes and decision-support tools

All states use some form of internal investment decision-making process to allocate funds to specific projects and programs. In some cases, these processes are supported by the objective analyses of decision-support tools. More often these processes are driven by the independent evaluations of field engineers, the legislative requirements of state and federal funding programs (i.e., the "color of money"), and political processes. Key objectives for this study were to: (1) document how decisions for preservation and capacity improvement investments are currently made within each state, and (2) determine what role, if any, travel demand plays in these decisions.

4.1.3 Travel Demand Measurement and Forecasting Capabilities

Current measures of travel demand

The potential use of travel demand measures within system preservation and expansion investment analyses is ultimately determined by the types of travel demand data collected (e.g., traffic counts, truck counts, travel time delays, and commodity flows), the comprehensiveness of this data (e.g., what portions of the network travel demand are available), and the frequency with which this data is reported (e.g., annually, biennially). Moreover, current travel demand data are prerequisites to the development of regional and statewide travel demand and truck forecasting models. This review documents the types of travel demand data collected by each participant state.

Travel demand forecasting

Reliable travel demand models are prerequisites to the accurate assessment of each state's long-term capacity improvement needs. Specifically, this information is required to answer questions such as: where are the corridors with the highest travel demand growth; where will congestion result in the most significant travel delay costs; where should investment be concentrated to best support the state's economic growth? In addition, travel demand modeling capability is also a critical input for benefit-cost analyses of major transportation investment projects and their alternatives. This review documents the auto and truck travel demand forecasting capabilities of each participant state.

4.1.4 Links Between TAM and Travel Demand Measures

As outlined in Chapter 3, the primary objective of these interviews was to identify and document all cases in which state DOTs have incorporated travel demand measures within the TAM process. Potential links between TAM and travel demand include the following:

Current and projected travel demand measures as inputs to the TAM process

- Infrastructure deterioration rates (e.g., roadway wear)
- Investment prioritization
- Project benefit-cost and alternatives analysis

Using the TAM process to address issues related to travel demand and transportation planning

- Capacity improvements
- Safety improvements
- Investment tradeoffs between preservation and capacity needs
- Objectives and performance measures

FHWA's Office of Asset Management and Office of Planning have teamed recently to provide guidance to state DOTs, MPOs, and other agencies responsible for transportation planning. Planners and MPOs "must balance funding realities with mobility needs," much in the same way that asset managers must balance funding realities with preservation needs. Because long-range planning typically lies within the realm of transportation planning, long-range planning and budgeting were not well-defined within each state's current asset management program, but were addressed in SLRPs. For this reason, consideration of these topics is discussed in greater detail in the next chapter, which details the contents and priorities of each state's current SLRP.

4.2 Michigan DOT (MDOT)

4.2.1 Organizational Structure of the State DOT

In Michigan, ownership of public highways and related infrastructure is distributed among MDOT and 616 other organizations, primarily counties and municipalities. In 1998, the state legislature established an Asset Management Council, independent of MDOT, and adopted *asset management* as the "way of doing business" for all of these organizations. The purpose of the Council is to recommend processes for developing and implementing asset management principles.

The most prominent organization in Michigan responsible for stewardship of highways is MDOT. Like counties and municipalities, MDOT reports to the Council and has undertaken a number of activities related to asset management. Within MDOT, for example, the Bureau of Planning's Asset Management Division at this time is largely responsible for collecting, analyzing, and providing data such as an infrastructure inventory, current infrastructure conditions, and future projected conditions to internal customers. Other divisions within the Bureau of Planning include the Statewide Planning, Intermodal Planning, and Project Planning divisions. These divisions also collect, analyze, and provide data. Statewide Planning, for example, is responsible for providing technical assistance to the various MPOs in Michigan and for developing a statewide transportation model. Exhibit 4-1 presents MDOT's organizational structure.

Data from the Planning Bureau becomes an important part of the project development and decision-making processes, which occur largely in decentralized fashion within MDOT's seven regions. Regional leaders produce prioritized lists of projects for rehabilitation and reconstruction of their infrastructure, which ultimately, through a resource negotiation process, are constrained and selected based on a variety of technical and non-technical criteria.

In Michigan, the legislature is the "champion" for asset management, which is carried out by the Asset Management Council statewide and by the Asset Management Division and other related divisions within the Planning Bureau at MDOT.

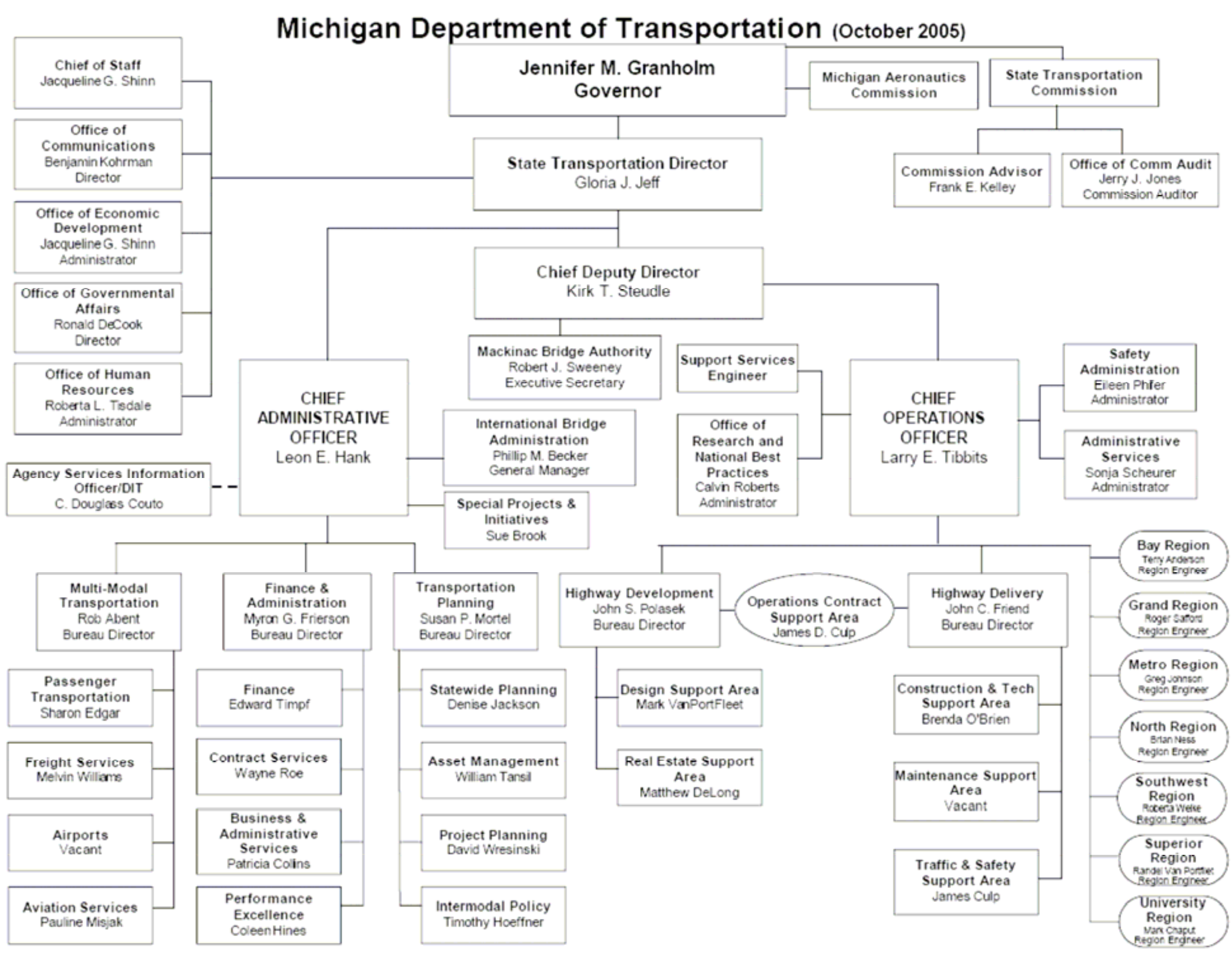


Exhibit 4-1: MDOT's organizational structure

4.2.2 Major Components of TAM Program

MDOT maintains one of the nation's most mature asset management programs. The following are descriptions of the key components of MDOT's existing asset management program.

Asset management as a "way of doing business"

Asset management in Michigan became a "way of doing business" when the state legislature mandated the use of TAM practices in 1998. Since then, MDOT has reorganized itself around this legislative requirement and focused on developing tools and processes that support responsible stewardship of existing transportation infrastructure in the state. This realignment of business processes has fostered development of a comprehensive approach to asset management across the state and has ensured broad support of asset management activities within MDOT.

Statewide process

The concept of asset management extends beyond MDOT and includes transportation agencies at all levels within the state, coordinated through the Asset Management Council. In support of this broad application of asset management, MDOT maintains a regular liaison with members of the Asset Management Council. This line of communication serves to promote coordination of investment activities across the state as well as provide a forum for sharing new asset management objectives and approaches. MDOT, the focus of this study, is only responsible for roughly 10 percent of all state centerline highway miles (about 10,000 centerline highway miles across the state); hence, ongoing communication and coordination between MDOT and the Asset Management Council ensures that a much broader share of the state's roadway infrastructure is encompassed within an asset management program.

Focus on preservation

As is the case for each of the states participating in this study, MDOT's asset management program is primarily focused on the maintenance and preservation of Michigan's state-maintained highways and related facilities. Within each state, this focus reflects the high cost of maintaining and preserving a large inventory of aging highway assets. Moreover, state legislation requires that 90 percent of all state transportation funds be committed to maintenance- and preservation-related activities. As a result of this policy, the availability of funds for new capacity-related projects is extremely limited. This situation focuses the current asset management program on the issue of preservation and significantly constrains the state's ability to address long-term travel demand- and performance-related issues experienced in the state's urban areas.

Goals, objectives and performance measures

The goals and objectives of MDOT's Asset Management Division fully reflect the focus on preservation, but do not currently emphasize travel demand-related issues. Specifically, the Asset Management Division has adopted these specific objectives:

- Maintain 95 percent of freeway and 85 percent of non-freeway state-owned pavements in "good" condition by 2008

- Maintain 95 percent of freeway bridges and 85 percent of non-freeway bridges in "good" condition by 2008.

In addition to these TAM program goals, MDOT has also adopted agency-wide strategic goals including preservation, safety, basic mobility, strengthening the state's economy, transportation service coordination, intermodalism, environment and aesthetics, and land use coordination. Chapter 5 addresses these strategic goals in more detail.

"Baseline" asset management tools

As with the other study state DOTs, MDOT employs pavement management, bridge management, and maintenance management systems. Each of these systems is supported by detailed asset inventories of the state's roadway segments, bridges, signs, guardrails, and other assets. MDOT staff are currently working to develop systems to inventory and analyze the investment needs of all ancillary infrastructure components not currently included within the state's existing management systems (e.g., pump stations and roadside rest areas). The ultimate goal is to ensure comprehensive coverage of all asset types.

Data collection and distribution

MDOT's Asset Management Division acts in many respects as an information repository. Its key mission is to manage and distribute high-quality data to all potential customers, both inside and outside of state government. These data include infrastructure inventories, infrastructure conditions, and current and forecast utilization (e.g., traffic volumes). Data management involves numerous stakeholders, from the personnel that collect data (data are collected by staff throughout MDOT), to the independent state agency that houses data, to the various internal and external customers that use data to improve their decision-making capabilities.

The data maintained by the Asset Management Division are housed in the Transportation Management System (TMS) database, which includes a basic inventory of highway assets and six additional components, including the following:

- *Bridge Management System (BMS):* This system includes bridge inventory, inspection, and work history data collected by staff in the Construction and Technology Division.
- *Intermodal Management System (IMS):* This system includes asset inventory for non-highway assets such as airports, border crossings, carpool lots, ferry services, and rail collected by a variety of specialists across MDOT coordinated by the Bureau of Transportation Planning.
- *Pavement Management System (PMS):* Sufficiency rating of highway segments based on an annual windshield survey that has been conducted since 1961. Staff from the Construction and Technology Division rate each segment on a subjective scale of 1 through 5. In addition, the PMS includes a rating, based on the more detailed pavement data collected biannually, that is used to determine the remaining service life (RSL) for each section of pavement.
- *Safety Management System (SMS):* MDOT's SMS includes crash records, road segment and right-of-way data, and intersection and interchange data, which allow users to summarize information of interest related to crashes and crash locations. the Traffic and Safety Division collects and maintains SMS data.

- *Congestion Management System (CMS):* The CMS tracks current measures of travel demand through annual traffic counts along the Michigan trunkline highway system. The contents of this database are described below under "current measures of travel demand."
- *Public Transportation Management System (PTMS):* PTMS includes a statewide vehicle inventory used for forecasting needs and a financial database for budgeting collected and maintained by the Division of Passenger Transportation, within the Bureau of Urban and Public Transportation.

In addition to the TMS, MDOT produces an annual *Sufficiency Report*, which contains detailed profiles of each segment of the state's trunkline highways. This includes the segment's geographic location, geometry, highway classification, number of lanes, AADT, estimated truck AADT, speed limit, pavement conditions, work history, capacity, travel forecast data, and other data. The majority of these data are also available through the TMS, which is part of the overall MAP database, a centralized statewide repository of data accessible by all DOT staff. Of particular convenience is the ability to key off of a geo-coded highway inventory when searching for data and information about roadway conditions and utilization. Effectively, between TMS, the *Sufficiency Report*, and linkages to the MAP database, the Asset Management Division is a "one-stop shop" for all data and information, including data and information related to travel demand, for state-owned infrastructure.

System preservation processes and decision-support tools

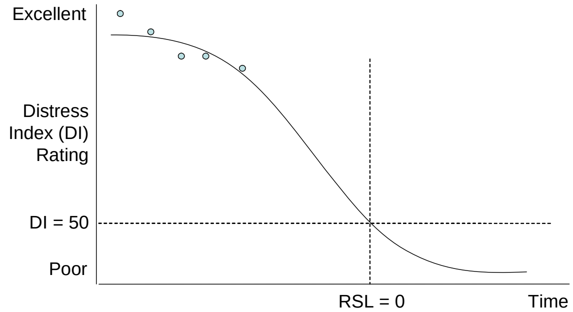
In Michigan, rehabilitation and reconstruction (preservation) projects are selected and prioritized at the regional level according to a detailed process that is uniform across all districts. These projects are then evaluated at the statewide level using the software program MAPSCORE, developed internally, which relies on a variety of measures to score the relative merits of various proposed and programmed projects, some of which include travel demand. These measures are:

- Remaining service life (15 percent)
- Road quality index (15 percent)
- Safety score (5 percent)
- District priority (25 percent)
- Cost per VMT per year (10 percent)
- Cost per lane-mile per year (10 percent)
- Return on investment (10 percent)
- Maintenance savings (10 percent)

MDOT's Road Quality Forecasting System (RQFS)

RQFS is a forecasting tool that predicts future performance of a pavement network under a variety of investment scenarios, allowing users to compare the relative merits of various strategic alternatives. RQFS inputs include the following:

- *Remaining Service Life (RSL) calculations.* RSL is a measure of how many years remain until reconstruction or major rehabilitation becomes the most cost-effective "fix" (i.e., preventive maintenance, rehabilitation, or reconstruction) for a segment (e.g., lane-mile) of pavement. Computing RSL is based on a standard deterioration curve and 3 or more observed distress index measures. Observations are illustrated as points along the sample curve below:



- *RSL distributions.* RQFS sums the number of segments by RSL. Next, the software computes the percentage of pavements in each of the 6 categories summarized below:

Category	RSL	Condition
I	0-2 years	Poor
II	3-7 years	Good
III	8-12 years	Good
IV	13-17 years	Good
V	18-22 years	Good
VI	23-25 years	Good

- *Cost matrices.* RQFS includes average project costs for the 3 types of fixes by type of pavement (e.g., freeway versus non-freeway), and by region within the state based on historical data.
- *Strategies.* A strategy is defined as the percentage of segments improved from one category to another each year (e.g., I to VI, II to IV, etc.). Each strategy has an associated cost.
- *Fix life values.* MDOT uses fix life values to determine how long pavements are expected to last and how many years a particular fix is expected to add to a pavement's life. Calculations of fix life values are based on the historical measured performance of various types of fixes.
- *Inflation.* Inflation of strategy costs is an optional RQFS feature.

Alternative strategies are developed based on the available resources and typically include a mix of fixes. Although RQFS does not select projects, users can identify the most cost-effective overall network strategy, then identify specific projects to achieve that strategy.

Some of the above measures are obtained using Michigan's Road Quality Forecasting System (RQFS), a pavement management tool that draws on current pavement age, condition data, and investment strategies to forecast future conditions. For example, Exhibit 4-2 provides a sample RQFS output based on a hypothetical investment scenario. The exhibit shows current and future RSL. The tool is also used to identify a cost-effective "mix of fixes" for pavement preservation. MDOT also maintains a similar program, the Bridge Quality Forecasting System (BQFS), for prioritizing bridge projects.

Over time, MDOT staff have continued to improve and refine their TAM capabilities and tools such that today, the staff's recommendations for system preservation activities are generally accepted by the state Transportation Commission, although the Commission may still exercise its discretion to alter resource allocation commitments. The analytical rigor of the state DOT's recommendations include the following:

- Decentralized development of lists of prioritized projects at the regional level, each following a uniform, highly-detailed prioritization process
- Usage of uniform, statewide data that feed the selection of projects at all levels
- Usage of the MAPSCORE project evaluation process, which compares projects across districts, and lends credibility to the estimation of future needs

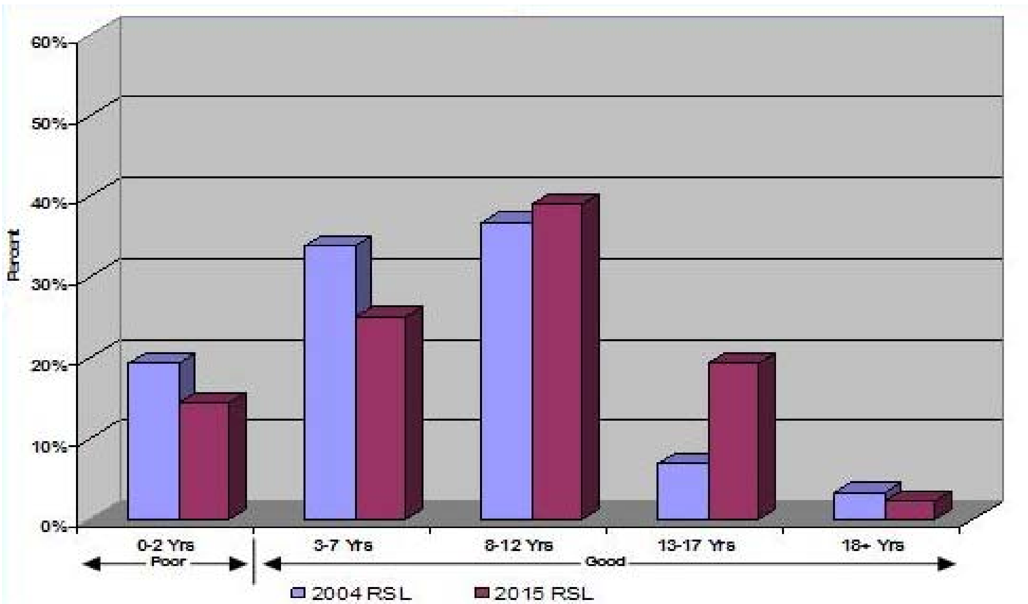


Exhibit 4-2: Example RQFS output based on a hypothetical investment scenario

Capacity improvement decision processes

Capacity-related projects in Michigan are prioritized by the Project Planning Division at the statewide level. Each proposed project undergoes an evaluation that is objective "to the extent possible." Analysts take a benefit-cost approach that draws on existing sources of data from the CMS and other sources to produce a score for each proposed project.

As noted above, Michigan law stipulates that 90 percent of all state transportation funds be devoted to preservation. Of the remaining 10 percent available for system expansion and other uses, most are dedicated to Congressionally-earmarked projects. As a result, the state Transportation Commission has not recently exercised its authority to decide allocation of resources to capacity-related projects.

MDOT's MAPSCORE

MAPSCORE is a decision-support software tool used by MDOT staff to provide input to professionals regarding the relative merits of various transportation projects. Since MDOT relies on its regional offices to a large extent for identification and prioritization of projects, MAPSCORE provides staff with an objective tool for verifying regional input and for providing feedback on the project prioritization process.

MAPSCORE uses a variety of input measures to produce a single evaluative measure for each project. Input measures include the following, each converted to a value ranging from 1-100 and weighted according to the percentages indicated:

- *Remaining Service Life (15%).* Score derived from the number of years remaining until reconstruction or major rehabilitation is the optimal fix for an asset.
- *Ride Quality Index (15%).* This score is based on values ranging from 1.0 to 5.0, as measured annually by MDOT staff.
- *Safety Score (5%).* The Safety Score is derived from MDOT's Sufficiency file.
- *District Priority (25%).* District Priority is based on a variety of specific criteria considered by an evaluation team: amount of category funds available, consistency with system fix strategy goals, maintenance costs, customer input, district priority in the SLRP, geographic location, traffic and corridor considerations, coordination with other projects, anticipated major new developments, and geometric and safety considerations. Essentially, these measures allow evaluators to consider qualitative benefits of a project that are difficult to capture such as the ability to combine with other projects, district equity, and customer input.
- *Cost per VMT per year (10%).* The cost of the project, the VMT within the project limits, and the fix life of the project are used to compute this measure.
- *Cost per lane-mile per year (10%).* The cost of the project, the number of lane-miles within the project limits, and the fix life of the project are used to compute this measure.
- *Return on investment (10%).* ROI is computed as the difference between user savings and project costs, divided by the fix life of the project. User savings are computed by multiplying $0.02 per VMT for autos and $0.10 for trucks.
- *Maintenance savings (10%).* This measure is computed by multiplying the number of miles of pavement by a value corresponding to the savings in maintenance costs accrued if the project were to be delivered.

Current measures of travel demand

Michigan tracks current measures of travel demand through annual traffic counts along its trunkline highway system. As noted above, these counts are maintained in the TMS. Specifically, these data include raw vehicle counts, classifications by vehicle type (e.g., small and large truck counts), intersection counts, speeds, travel time delays, and special studies.

Travel demand forecasting

MDOT currently produces a statewide travel demand model and, like many states, is in the process of refining and improving the model's capabilities and uses. In addition, there are 12 MPOs in Michigan, each of which produces its own regional travel demand forecasts (7 of which are maintained by MDOT staff on behalf of some of the state's smaller MPOs). Input data for the statewide model include the MPO models themselves, traffic counts from the primary highway network, and projected growth rates in population. Model outputs include projected traffic flows, estimated travel speeds, travel paths, commodity flows, and VMTs. The travel demand model is used to estimate future congestion (i.e., volume-to-capacity ratios), VMT, level of service (LOS), and future highway user-tax revenues. In addition, the output data are co-located with other data (e.g., location, roadside features, and pavement condition of highway segments or links) and are accessible by all internal DOT customers for their own independent analyses. MDOT also has a truck model used to analyze current and project future truck movements throughout the state. The Transportation Planning Division uses these data as inputs for validation of the statewide travel demand model. Like many state DOTs, MDOT is in the process of refining and improving the model's capabilities and uses. Although not all aspects and data that compose the modeling process are captured specifically in the CMS, all model outputs are made available through the TMS.

MDOT's *Integrated Call for Projects*

In order to ensure that district-recommended reconstruction and rehabilitation (preservation) projects can be evaluated commensurably at a statewide level, MDOT requires that district managers submit their annual project lists together with detailed information about the projects, their costs, their geometry, their impacts, and other features.

Following are specific considerations that are required elements of each districts submittal to the annual *Call for Projects*:

- Context-sensitive solutions
- Control sections and physical reference numbers
- Environmental justice
- Inflation
- Permanent traffic recorders
- Programming of projects
- Program/project management system
- Project support of economic development
- Review and analysis forms
- Road Quality Forecasting System (RQFS)
- Statewide Transportation Improvement Program (STIP) requirements
- Submittal of notebooks and CDs—format, number of copies, and location
- Submittal checklist

Once compiled, the data gathered through the *Call for Projects* provide statewide staff with yet another tool for evaluating the relative costs and benefits of projects across all districts. Together with input from RQFS and MAPSCORE, asset managers can draw on the *Call for Projects* documentation as a reference point for developing statewide prioritization of preservation projects. In addition, decision makers can use information from the *Call for Projects* for further analysis of a

4.2.4 Links between TAM and travel demand measures

Following are documented ways in which travel demand data are used by MDOT to support asset management processes or where asset management processes are used to address future travel demand issues.

Roadway wear

As with most other states, MDOT uses estimates of future equivalent single-axle loadings (ESALs) during initial pavement design. While this process generally ensures that pavement standards are sufficient to sustain future traffic volumes and truck weights, the volume of traffic actually realized can differ from that predicted during the design phase, potentially leading to accelerated rates of pavement deterioration.

To account for this and other deterioration drivers, MDOT models deterioration of pavement on a segment-by-segment basis by fitting curves to observed pavement condition data over a period of at least three years (i.e., at least three data points are required to create a deterioration model for a given segment). These segment-specific curves are then used to predict future pavement deterioration on each individual stretch of roadway. While this pavement deterioration modeling process does not make *explicit* use of current travel demand measures for each segment, the process of using segment-specific models (based on segment-specific historical data) does yield an *implicit* measure of the impact of auto and truck demand on pavement deterioration.

Re-investment prioritization

Travel demand measures are built into the decision-making process for preservation projects by way of the MAPSCORE project evaluation process. In addition to other project evaluation criteria (see callout box), MAPSCORE considers the travel demand related measures of project cost per VMT and return on investment (ROI). The first measure focuses on cost per mile of travel on rehabilitated facilities, while the second incorporates measures of user benefits (travel time reductions) that scale as travel demand increases. Using this process, MAPSCORE helps to ensure objective and consistent project selection across each MDOT district.

Capacity improvement identification and evaluation

MDOT uses the results of the statewide travel demand and truck models as well as output from the local MPO models to help identify capacity needs. Using output from these models combined with other related measures (e.g., LOS, trade, population, employment), MDOT has identified several prioritized "corridors of highest significance" requiring major capacity improvements. MDOT's "corridors of highest significance" are discussed in detail in Chapter 5.

As with other states included in this study, MDOT also uses travel demand forecasts to help evaluate the cost-effectiveness (benefit-cost analysis) of major investment projects and their alternatives.

Safety

MDOT maintains crash data used to identify the locations of "problem areas" on its network. Analyses of these data are then used to help target the location of safety-improving investments. In practice, the implementation of safety-improving investments is frequently coordinated with other required investment activities (e.g., preservation, expansion). In addition, MDOT uses its historical crash rate data combined with traffic count data to pre-position emergency response equipment, particularly during periods of high traffic demand or inclement weather.

Trade-offs between preservation and capacity enhancement

As already noted, the Michigan legislature has mandated that the state devote 90 percent of transportation resources to preservation, maintenance, safety, and operations of existing facilities. In general, the remaining 10 percent of funds are available for capacity enhancement, but often must be applied to specific, Congressionally mandated projects. This situation naturally constrains MDOT's ability to "optimize" the allocation of funds between these two investment options.

Performance measures and objectives

MDOT's performance targets, like its TAM program, are preservation-focused. In contrast, the agency's strategic goals and objectives (as identified in MDOT's long-range transportation plan) do include travel demand and travel demand management-related goals such as mobility and land use coordination. Long-range goals and objectives are discussed further in the next chapter.

4.3 Utah DOT (UDOT)

4.3.1 Organizational Structure of the State DOT

Like MDOT, UDOT operates in a somewhat decentralized fashion. Project recommendations are made at the headquarters or central office through tactical and strategic asset management practices. These recommendations form the 10-year Preservation Plan and are incorporated into UDOT's SLRP. The two plans are then used by leaders within each of the department's four regions to produce the STIP that looks at four years of committed projects and a further two years of concept development projects. Also like Michigan, this allocation is informed by quality data and decision-support tools that have earned UDOT strong credibility with its politically appointed Transportation Commission, upper management, and state legislature. Exhibit 4-3 presents UDOT's organizational structure.

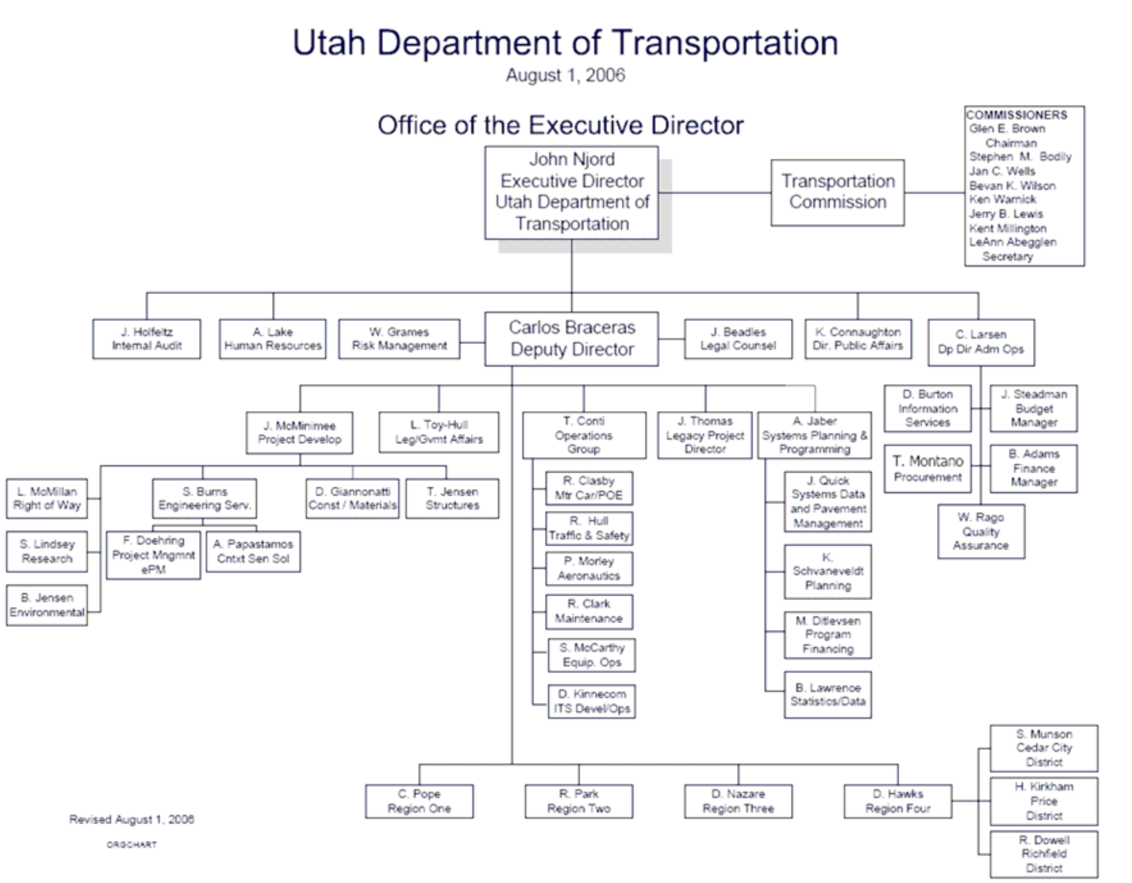


Exhibit 4-3: UDOT's organizational structure

Asset management principles have been adopted by UDOT's Systems Planning and Programming group, which include the Systems Data and Pavement Management, Planning, Program Financing, and Statistics/Data divisions. Staff in these divisions collectively carry out the collection of system inventory and condition data, technical support for MPO models, project-specific traffic modeling, monitoring of system performance relative to performance standards, optimization of investment scenarios, and recommendation of resource allocation. Programming of preservation projects is based largely on the data and recommendations produced by the Systems Planning and Programming staff, but project selection occurs at the regional level.

In Utah, the Systems Planning and Programming group is the "champion" of asset management, and its success is evidenced by the credibility that their products enjoy with decision makers.

4.3.2 Major Components of UDOT's TAM Program

As with the other participant states, asset management at UDOT tends to be preservation oriented. The following are descriptions of the key components of UDOT's existing asset management program.

Focus on preservation

UDOT's policy is to address all preservation needs for existing infrastructure before committing funds to expansion projects. Given the limited availability of state funds and the common challenges of preserving an aging highway system, UDOT has had limited ability to fund expansion projects in the recent past. As in Michigan, this has resulted in the deferral of capacity-related projects. However, the strength and credibility of the asset management program's analyses have yielded increases in available funding for expansion projects, with positive impacts to the state's highway users.

Goals, objectives, and performance measures

UDOT has established its "final four" strategic goals, which are to "take care of what we have," "make the system work better," "improve safety," and improve capacity." The TAM program addresses each of these goals through a variety of objectives, which include those listed below. UDOT has a policy that defines a hierarchy of how funds are allocated between three of the four strategic goals. Funds are allocated to: first, "take care of what we have;" second, "make the system work better;" and third, "improve capacity;" while dedicating funds to "improve safety." This prioritized ordering of these goals reflects the state's current emphasis on system preservation (the first goal) versus the travel demand-related goal of capacity improvements (the last goal).

- Take care of what we have.
  - Maintain 90 percent of freeway pavements, 70 percent of arterial pavements, and 50 percent of collector pavements in fair or better condition.
  - Maintain 65 percent of bridges in very good condition, 25 percent of bridges in good condition, and 10 percent of bridges in fair condition.
  - Maintain a grade of "B+" for snow and ice removal. The maintenance management system assigns a grade for snow and ice removal, with A for "clear, dry conditions" and B for "occasional snow or ice build-up."
  - Maintain a grade of "A" for signing and striping. The maintenance management system assigns a grade for signing and striping, with A for "excellent daytime and nighttime visibility" and B for "good daytime visibility and fair nighttime visibility."

- Make the system work better.
  - Increase annual usage of 511 (phone) and CommuterLink (web) traveler information sources by 10 percent.
  - UDOT will soon begin polling motorists to determine the percentage who change their travel patterns based on information received through 511 or CommuterLink. At this time, they have not established an objective relative to the information that will be gathered through the polls.
  - Clear non- or minor-injury crashes in 30 minutes or less on average, serious-injury crashes in 60 minutes or less on average, and fatal accidents in 120 minutes or less.
- Improve safety.
  - Reduce the number of traffic-related fatalities by 2 percent each year.
  - Reduce the number of pedestrian fatalities by 2 percent each year.
- Increase capacity.
  - UDOT is measuring baseline travel times between various intersections along the Wasatch Front (Interstates 15 and 80 in the Salt Lake City area). Once a baseline has been determined, UDOT will establish objectives relative to travel times.

"Baseline" asset management tools

As with each of the other study states, Utah employs pavement management, bridge management, and maintenance management systems for the ongoing maintenance of highway and highway-related infrastructure. Each of these systems is supported by databases housing inventories of the state's highway related assets including pavement, bridges, signs, guard rails, and other facilities. UDOT has integrated these tools into a comprehensive asset management system (AMS).

Data collection and distribution

UDOT has developed an AMS within the commercially available software package called dTIMS CT. The AMS uses data and models from the other tactical management systems and houses data similar to MDOT's TMS, including asset information data such as inventory, conditions, and crashes, and travel demand data such as AADT and travel forecasts. Data related to TAM are collected similarly in Utah as in other states; each management system (bridge, pavement, safety, and maintenance) has its own source.

- *Bridge:* Bridge data are collected and maintained in PONTIS through biannual inspections. PONTIS data are exported to the AMS for an overall network analysis and then, once the network-level analysis is completed, analyzed within PONTIS to determine project-level decisions.
- Pavement: Pavement data are collected through an annual distress survey, which consists of both automated and manual components (manual "asphalt ride" windshield survey and automated International Roughness Index tests). The pavement management group uses its own dTIMS CT database to store and analyze the pavement data to produce the pavement management program.
- Safety: Raw accident data are summarized and a safety index calculated by the asset management team at UDOT using three-year average crash statistics stored within dTIMS

CT. This safety index is then analyzed within dTIMS CT to produce a safety program, which is then provided to Traffic and Safety for final program development.

- Maintenance: UDOT's maintenance management system consists of work histories and annual inspections of facilities statewide. These data are currently exported to the AMS, and a preliminary analysis is completed within the AMS similar to the safety analysis.
- UDOT then performs a strategic analysis, including cross-asset analysis and optimization across the asset groups. Currently, UDOT has implemented pavements, bridges, safety, mobility, and maintenance analyses into the dTIMS CT AMS.

System preservation processes and decision-support tools

Utah has completed the implementation of the decision-support software tool dTIMS-CT, which analyzes alternative infrastructure preservation and maintenance investment scenarios and produces "optimal" resource-allocation strategies. Although initially focused on pavement preservation alone, dTIMS CT has been implemented to allow for a more complete analysis of all project types, including pavements, bridges, safety, maintenance, and capacity projects. The goal of the AMS is to allow analysts to produce "apples-to-apples" measures of the benefits of all projects relative to UDOT's goals and objectives.

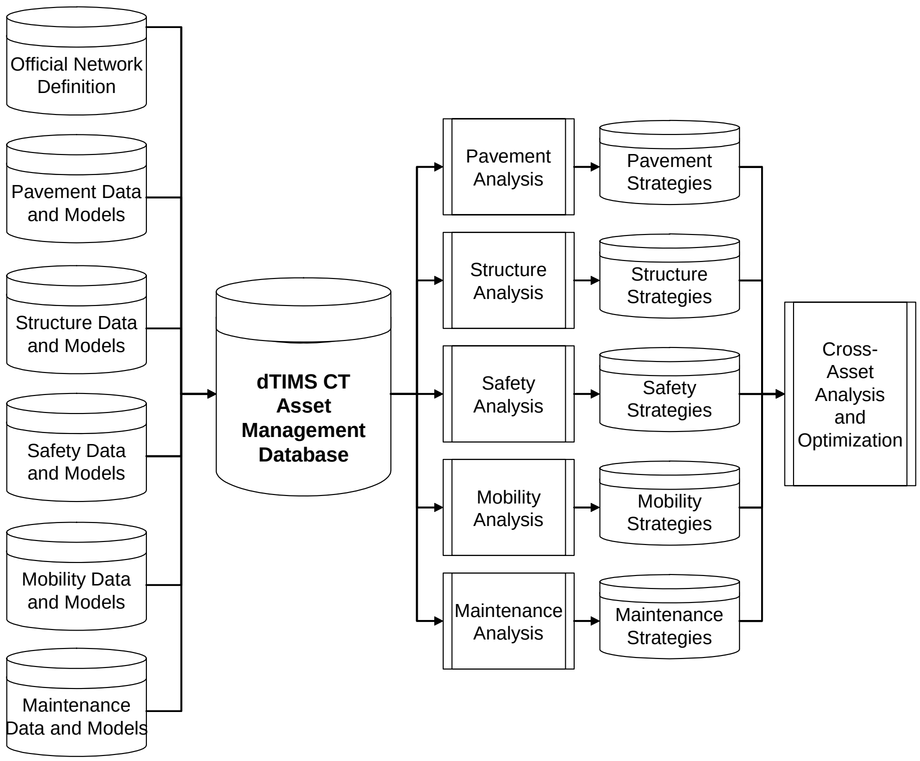
In recent years, the results of scenario analyses produced with the help of dTIMS CT are typically adopted as a baseline for consideration by decision-making bodies (including the four geographic divisions and the statewide Commission). UDOT maintains a high level of credibility with the state legislature and with transportation decision-making bodies because of its ability to present, with the help of dTIMS CT, the consequences of changes in levels and mixes of investments in preservation.

UDOT's toolkit for presenting information related to preservation needs includes a 10-year Preservation Plan as well as output from the dTIMS CT AMS.

<u>UDOT's dTIMS CT Asset Management System Software</u>

UDOT purchased the dTIMS CT software initially to serve as a pavement management tool, but has retained Deighton Associates Limited, the software developer, to assist with implementation of a more comprehensive, "enterprise-wide" Asset Management System (AMS).

A key feature of UDOT's enterprise-wide effort was the implementation of an AMS that could consider and optimize investment strategies for one or more "asset groups." Examples of asset groups are pavements, structures (e.g., bridges), safety, and maintenance; most state DOTs have developed or are developing similar management systems. UDOT has expanded that list, however, to include *mobility* as an asset. While deterioration for pavements and bridges follow predictable patterns that can be represented as curves, UDOT has suggested developing a similar curve that tracks and predicts the deterioration of mobility over time based on current congestion data and travel demand forecasts.



UDOT's AMS within dTIMS CT has been configured by UDOT and Deighton to have the following capabilities:

- Determine the funding level required for any single asset group to maintain a desired level of service
- Determine the level of service for any single asset group based on various funding level scenarios
- Determine the optimal maintenance and rehabilitation strategy for any single asset group based on an unlimited number of possible funding scenarios
- Determine the optimal funding level between all asset groups by performing a cross-asset analysis and optimization
- Determine the resulting level of service for all asset groups based on various funding scenarios

Conceptually, UDOT's AMS functionality includes the ability to produce investment strategies within and across asset groups, including investment strategies related to both preservation and expansion of physical networks. The relationships built into the asset management database are illustrated above.

UDOT's asset management strategy consists of four different levels of asset management analysis that are integrated to produce a consistent set of recommendations:

- *Strategic Asset Management Analysis:* Data and models from the tactical asset groups (Pavement, Bridge, Safety, Mobility, and Maintenance) are loaded into the dTIMS CT AMS and analyzed to determine budget allocations for each asset group using a traditional "stove pipe" or "silo" analysis as well as using the "cross-asset analysis and optimization" functionality of the AMS. These budget recommendations are presented ultimately to the Transportation Commission. Once the budget allocations are approved, the budgets as well as the output from the dTIMS CT AMS analysis are distributed to the different asset groups so that the tactical asset management analysis can be completed.
- *Tactical Asset Management Analysis:* The tactical asset management groups use the budget allocations and project recommendations from the strategic asset management analysis as input into the asset group systems. These inputs are entered into the respective asset group systems and the analysis completed using decision-support tools such as dTIMS CT and PONTIS as well as other manual data and processes to develop the recommendations from the tactical asset groups. The result of this analysis is a tactical program that forms the basis of the UDOT 10-Year Preservation Plan.
- *Long-Range Planning:* Once the 10-Year Preservation Plan is developed, the Planning Division then incorporates its recommendations into the SLRP, where transportation planning, travel demand, MPO input, and corridor development plans are completed. The SLRP may impact the strategic and tactical analyses, which may necessitate further analysis at the tactical and strategic levels as corridors are committed in specific years for redevelopment.
- *Operational Asset Management:* Finally, the UDOT Regions put together the STIP using recommendations from the strategic, tactical, and long-range plan components.

In time, UDOT desires to have all of the 10-Year Rehabilitation and Preservation projects and STIP projects come from the SLRP.

UDOT and MDOT asset management at the local level

All states participating in this study are focused on developing asset management practices for application at the statewide level to state-owned assets. Yet, with the exception of North Carolina, state DOTs own fewer than 10% of highway centerline-miles. The majority of the remaining facilities are owned and managed by counties and municipalities. In both Utah and Michigan, asset management principles are being promoted at these local levels.

In Michigan, the legislature established an Asset Management Council, independent from MDOT, which is responsible for coordinating asset management activities with all 617 highway-owning agencies across the state, including counties, cities, townships, and villages. The Council distributes technical guidance and supports pavement condition data collection and analysis using the RoadSoft software program.

In Utah, FHWA's Local Technical Assistance Program (LTAP) was established at Utah State University in 1988. LTAP transfers technologies and technical guidance from FHWA, UDOT, and universities to local agencies through workshops, a lending library of various informational products, newsletters, and special projects. One special project developed an asset management tool for local agencies. The tool comprised basic inventory, condition, and forecasting components that local agencies could use to monitor and predict needs, including needs for maintenance of signs, signals, pavements, and other assets.

Capacity Improvement decision processes

Utah faces a constraint similar to Michigan for capacity-related projects, in that additional state resources have been dedicated to Utah State Legislature-earmarked projects. As a result, decision makers have not been faced with tradeoff decisions related to travel capacity projects and programs. Nonetheless, UDOT has expanded the dTIMS CT AMS capability to include consideration of capacity projects, which will allow for cross-asset allocation of resources among preservation, maintenance, and expansion investments.

In the absence of a dTIMS CT decision-support tool to prioritize capacity projects, UDOT's Project Planning and Programming Division is responsible for recommending capacity-related projects among the four UDOT regions based on travel demand. Prioritization is based primarily on historic population growth trends from the State Budget Office and the list of prioritized projects as identified by the regions.

Statewide Processes

Similar to Michigan, the concept of transportation asset management extends beyond UDOT and is currently practiced by a variety of local and county agencies around the state. Less structured than in Michigan, asset management at the local level within Utah is autonomous from other towns and counties and is also less influenced by UDOT's own TAM program. Here communities desiring asset management can reach out to the Utah Local Technical Assistance Program (LTAP) Center. This center was established to:

- Transfer highway technology from FHWA, UDOT, and universities to local transportation agencies
- Provide an avenue of feedback from local transportation agencies to UDOT, FHWA, and universities on local transportation needs.

The Center is working with communities desiring asset management to collect data on the configuration, condition, and performance of locally owned roadway infrastructure and then help the locality develop its own re-investment programs using LTAP's own decision support software. As with Michigan, this broader application of asset management principles within the state ensures that a greater proportion of roadway assets are governed by such principles (i.e., more than the roughly 10 percent of center-line miles maintained by UDOT).

4.3.3 Travel Demand Measurement and Forecasting Capabilities

Current measures of travel demand

Utah tracks current measures of travel demand through traffic counts throughout the state highway system. These counts are reported as AADT and by vehicle type ("classification counts"). Volume estimates are derived from 48-hour counts and summarized monthly and annually for each state route. Data are collected annually for the entire network.

Travel demand forecasting

UDOT currently does not produce a statewide travel demand model; however, there are four MPOs in Utah, each of which produces a regional travel demand model. UDOT provides technical assistance to three of these MPOs. Input data for the models include traffic counts from the primary highway network and projected growth rates in population. UDOT does have a statewide traffic forecasting tool that draws on 10 years of AADT records to estimate future levels of traffic along the state highway network. All of these activities take place within the Planning Division. These future levels of AADT are loaded into the dTIMS CT AMS for use in the analysis of the various assets considered within the AMS.

4.3.4 Links Between TAM and Travel Demand Measures

Following are documented ways in which travel demand data are used by UDOT to support asset management processes or where asset management processes are used address future travel demand issues.

Roadway wear

UDOT does not use measures of travel demand to predict future deterioration rates of highway infrastructure. Rather, UDOT follows the common practice of using estimates of future ESALs during initial pavement design for a new or rehabilitated facility. The dTIMS CT model will then assume that the deterioration of that pavement will reflect the average deterioration rate for that pavement type and thickness, with no consideration of the potential acceleration (deceleration) of pavement wear due to higher (lower) than expected traffic volumes.

As with the other participant states, UDOT also conducts annual condition inspections of pavement throughout its network. These annual inspections provide an alternate means of capturing the impacts of accelerated (decelerated) pavement wear due to high (low) traffic volumes.

Investment prioritization

UDOT prioritizes preservation projects (e.g., pavements and bridges) based on their benefits and costs using the dTIMS CT optimization, decision-support software tool. dTIMS CT estimates user benefits for preservation projects (including bridges, pavements, and maintenance) by incorporating travel demand measures (e.g., VMT) as a factor in the project evaluation score, similar conceptually to the MAPSCORE program in Michigan. Outputs that the system produces can include any of the following:

- Funding levels required for any single asset group to meet a performance standard
- Performance levels for any single asset group based on funding levels
- Optimal maintenance and rehabilitation strategies for any single asset group based on any conceivable funding scenario
- Optimal funding levels between all asset groups through cross-asset analysis and optimization
- Performance of all asset groups based on funding levels.

Regions use these recommended prioritization lists as starting points for determining the projects in which they would prefer to invest

Capacity improvement requirements

Capacity expansion in Utah is constrained by a combination of the UDOT policy that preservation needs be addressed first and a lack of available funds to address all preservation needs. However, the prioritization process for capacity is based on the statewide travel demand model and MPO models, which identify areas of high congestion.

In the absence of a more sophisticated dTIMS CT model to prioritize capacity projects, UDOT's Project Planning and Programming Division is responsible for recommending capacity-related projects among the four UDOT regions and does so based on forecast travel demand (from local MPOs) and from the output of a preliminary analysis within dTIMS CT. Final prioritization is based primarily on historic population growth trends from the State Budget Office and the list of prioritized projects as identified by the regions.

Safety

Utah does not currently use travel demand measures to help identify areas for safety investment.

Trade-offs between preservation and capacity enhancement

Once again, UDOT policy is that all preservation needs be met before allocating funds to capacity enhancement. This and the state's funding constraints prevent UDOT from addressing most capacity needs. At the same time, UDOT's "final four" strategic goals are:

1. Take care of what we have (i.e., preservation)
2. Make the system work better (i.e., operations)
3. Improve safety
4. Increase capacity.

Together, these constraints and prioritized goals effectively pre-determine the investment tradeoffs for preservation versus capacity improvements. Despite these constraints, UDOT is moving ahead to expand the dTIMS CT-implemented mobility models to conduct more sophisticated analytical tradeoff analyses between preservation and capacity improvements.

Performance Measures and Objectives

UDOT has established performance measures that align with the four strategic goals listed above (preservation, operations, safety, and congestion). The agency has not yet, however, defined standards for the congestion performance measure (travel times between various intersections along Interstates 15 and 80 in the Salt Lake City area) because of difficulty in establishing baseline travel times. Performance is reported annually.

4.4 California DOT (Caltrans)

4.4.1 Organizational Structure of the State DOT

Exhibit 4-4 presents Caltrans' organizational structure.

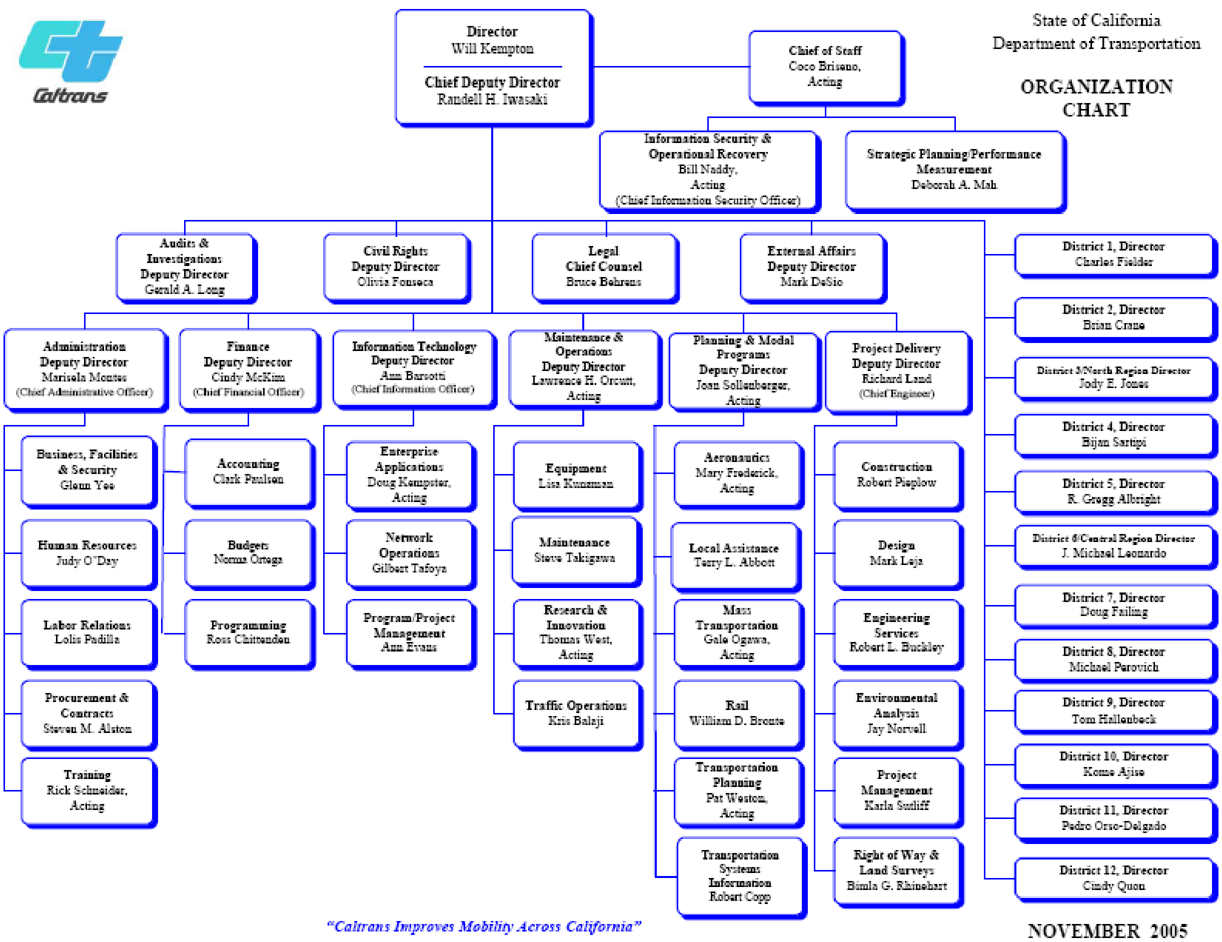


Exhibit 4-4: Caltrans' organizational structure

Caltrans does not currently have staff dedicated wholly to "asset management." The organization's leadership, however, is establishing organizational and transportation system performance measures that ultimately will spread throughout Caltrans and help to shape the way that the state invests in infrastructure. In addition, there are several asset management-related activities ongoing within various segments of the organization. First, the Transportation Systems Information division collects and maintains inventory data for Caltrans highways. Also, staff within Maintenance and Operations utilize pavement, bridge, and maintenance management systems, which are used to help prioritize projects within each of those areas.

Capacity projects and preservation projects in California are developed and programmed separately. Capacity projects are identified and developed by staff in the Planning and Modal Programs group, and these projects ultimately, with input from Districts, are programmed into the STIP. Preservation, maintenance, and operations projects and programs, on the other hand, are identified by staff in the Maintenance and Operations group and ultimately are programmed into the State Highway Operations Preservation Program (SHOPP).

4.4.2 Major Components of Caltrans TAM Program

Despite the absence of an official asset management program, Caltrans staff were eager to participate in the study with the objective of learning more about asset management practices and how the state can benefit from the experiences of other states. The following describes those management processes utilized by Caltrans that most closely match the roles, responsibilities, and principles of TAM.

Performance measures

Caltrans recently began developing high-level organization-wide goals and performance measures, including measures that apply to Caltrans organizationally and others that apply to the performance of the transportation system. This program enjoys the support of upper management and ultimately aims to provide common goals, objectives, and measures for use across the organization. Key organization-wide goals include:

- *Safety:* Provide the safest transportation system in the nation for users and workers.
- *Mobility:* Optimize transportation system throughput and provide dependable travel times.
- *Delivery:* Improve delivery of projects and services.
- *Flexibility:* Provide mobility choices through strategic partnerships.
- *Stewardship:* Preserve and enhance California's resources and investments.

Here mobility is the only goal relating directly to travel demand concerns.

Caltrans also publishes a 10-year SHOPP Plan, which identifies all system preservation needs for the upcoming 10-year period. Project selection for the 2005 ten-year SHOPP Plan was guided by the following goals (closely related to the agency wide goals as stated above):

- *Safety:* The Plan includes strategies and targeting funding levels that will improve motorist and worker safety.
- *Performance:* The Plan includes operational, technology, and system management improvements that optimize the system throughput.
- *Reliability:* The Plan identifies the preservation and rehabilitation needs of the State's bridges and highways to maintain a reliable system. The Plan also identifies mobility and operational needs to reduce congestion and increase reliability.
- *Stewardship:* The main objective of the Plan is to preserve and protect the State Highway System, one of the State's most valuable resources.

Note that the above strategic goals and objectives, even those specifically addressed by the SHOPP plan, are aimed at both preservation- and capacity-oriented needs. In addition, the DOT-wide objectives have not yet been applied to or refined by asset managers or other divisions within Caltrans for whom the objectives are intended.

"Baseline" management systems

California's current asset management activities are focused on the traditional suite of management systems for assets, including bridge, pavement, and maintenance management systems. These systems are used to house and manage transportation system data. In addition, these tools include features that allow users to analyze various investment scenarios to better understand the impacts of allocating resources. For example, Caltrans uses PONTIS as a tentative baseline estimate of bridge needs, but the software does not capture some risks well (e.g., seismic and scouring problems). Consequently, analysts combine PONTIS results with other information to develop estimates and allocation recommendations manually. As another example, the pavement management system produces similar results as PONTIS, but also encounters a similar shortcoming—the investment scenario recommended by the system serves as a baseline, but is subject to substantial revisions by analysts based on other information.

Data collection and distribution

Asset inventory, condition and performance data are collected by several distinct Caltrans divisions:

- The Division of Transportation Systems Information (TSI) provides Geographic Information System (GIS) capabilities through its Office of GIS.
- The Division of Operations collects and maintains crash data in the Traffic Accident and Safety Analysis System (TASAS).
- The Division of Maintenance's Roadway Program performs visual and instrumented (International Roughness Index) pavement inspections annually for all state-owned roads and manages these data in a pavement management system database.
- The Division of Maintenance's Office of Structure Maintenance and Investigations performs bridge condition inspections biannually for all state-owned bridges. Bridge inspections consist of a condition report and additional information based on the professional opinion of the inspectors, all of whom are licensed engineers. Additional information could include, for example, information about vehicular traffic, if the engineer deems traffic to be a significant feature of a particular bridge. Bridge data are managed by the Office using PONTIS.
- The Division of Maintenance's Integrated Maintenance Management System (IMMS) is currently being further developed

<u>Caltrans' Integrated Transportation Management System (ITMS)</u>

Caltrans has been developing and refining its Intermodal Transportation Management System (ITMS) over the past several years. ITMS is a macro-economic tool designed to provide comprehensive analysis of and coordination of planning for a broad range of transportation projects spanning all modes, accessible to planners from all twelve Caltrans Districts and other planning agencies.

Completing the ITMS involved the establishment of multimodal performance measures across modes in five key areas: mobility, financial, safety, economic development, and the environment. In addition, Caltrans developed demand and cost data for passenger and freight movements (all modes) for the base year, and for 10-, 20-, and 30-year horizons. Ultimately, this led to the provision of a computer and database architecture capable of integrating data analysis, forecasting, and GIS capabilities.

ITMS includes the major functions of asset management; specifically, it recognizes performance measures, provides planners at several levels the ability to coordinate project planning by using common data, develops consistent information, and performs credible analyses that support better decision making.

and will allow for a centralized repository of data related to work performed on specific pieces of the system and costs of maintenance.

System preservation processes and decision-support tools

The recommendations of the SHOPP (preservation plan) are generally approved by the State Transportation Commission because SHOPP's preservation-oriented projects and built-in prioritization process have input from both district engineers and statewide asset managers. Within this plan, the prioritization of preservation funds between pavement, bridges, and maintenance is determined by a combination of historic funding allocations to each of these uses and upper management decisions based on the input of regional engineering staff and headquarters staff responsible for each asset class (i.e., there are no decision support tools to support this process). In addition, the 10-year SHOPP Plan, which projects future preservation needs, offers decision makers a "preview" of future SHOPPs.

Caltrans does not actively utilize any decision-support tools beyond traditional management systems for assets, but is working to re-implement its Intermodal Transportation Management System (ITMS) tool (see callout box).

Capacity improvement decision processes

There is no rigorous analytical decision-support process for capacity-related projects at the statewide level in California, the reason being that 75 percent of available STIP (i.e., capacity improvement) funds are allocated to independent regional transportation planning agencies (RTPAs) as defined under state statute. Consequently, those agencies, which include MPOs, conduct their own investment prioritization analyses with minimal input from headquarters staff. This decentralized approach, in which each region is free to use its own methods to prioritize projects, leads to varying levels of sophistication with regard to project selection. The 25 percent of available STIP funds that are allocated to interregional projects, as part of the Interregional TIP (ITIP), meanwhile, are distributed based on an allocation formula to projects that are consistent with priorities described in the statewide Interregional Transportation System Plan (ITSP).

Overall, decision makers have few "levers" to pull with regard to the allocation of expansion project funding in California due to the formula allocation of resources programmed into the STIP. Decision makers can, however, impact the total allocation to the STIP. In fact, recently, the STIP allocation was temporarily suspended as a consequence of the state's recent funding problems. If funding is restored, the total funding levels will be at the discretion of lawmakers, with allocation again relying on the STIP formulas.

Limited resources

Given its high rate of growth and diverse needs, California has felt resource constraints more acutely than other states. For example, whereas other states program expansion projects and some preservation projects as part of a STIP, California transportation agencies develop two distinct programs, one for expansion-related projects (STIP) and another for highway preservation- and operations-related projects (SHOPP). In recent years, funding for the STIP has been committed to other non-transportation needs of the state. In this regard, Caltrans staff agreed that the state has become "preservation-focused," despite the growing travel demand.

4.4.3 Travel Demand Measurement and Forecasting Capabilities

Current measures of travel demand

The Division of Traffic Operations' System Management Planning group conducts an annual screen-line survey (traffic count). This survey gathers sample counts of traffic volumes, including trucks, at numerous points of the state highway network, reported annually as AADT. In addition, the Motor Vehicle Stock, Travel, and Fuel Forecast (MVSTAFF) estimates current and future projected numbers of registered vehicles, VMTs, and fuel consumption.

Statewide travel demand models

Statewide travel demand models are a "recent phenomenon," with the most advanced models emerging in the last 10 years. The participating four states are at varying stages of model development, reflecting the fact that across the nation many states have yet to develop any models, others are considering investment in a model, and still others have developed sophisticated models that consider all modes of passenger and freight travel, drawing on numerous sources of data.

Statewide travel demand models help DOTs to think more strategically about where future capacity investments will provide the highest long-term payoff. Benefits include:

- Identification of corridors and bottlenecks that should be targeted for capacity expansion, multi-modal development, or other strategies for congestion relief.
- Identification of highway segments with safety improvement needs.
- Identification of existing and forecast freight movement needs, which could lead to changes in investment in roadway preservation.
- Identify which corridors are crucial to the state's long-term economic growth.

Travel demand forecasting

The TSI's Office of Travel Forecasting and Analysis produces and manages the statewide travel demand model, which projects VMT and volume-to-capacity ratios on the intercity state highway network based on a decennial household travel survey. Modes included in the model, which projects travel from 2000 to 2025, include air, rail (Amtrak), intercity bus, and highway. This information is provided as requested by MPOs and RTPAs as an input to their regional travel demand models. Travel demand forecasts are also often produced by TSI on smaller scales to support project-specific analyses. The Office also produces an annual MVSTAFF report, which estimates current and future projected numbers of registered vehicles, VMTs, and fuel consumption (forecasts are based on current and projected socioeconomic attributes such as population, income, fuel price, interest rates, and assumptions regarding fuel economy).

In the past, TSI has relied on screen-line truck counts to model truck flows on the intercity network. Staff indicated that these data are not reliable and that the division is currently undertaking a study to construct a truck model.

4.4.4 Links Between TAM and Travel Demand Measures

Following are documented ways in which travel demand data are used by Caltrans to support asset management processes or where asset management processes are used to address future travel demand issues.

Roadway wear

Caltrans does not currently use measures of travel demand to predict asset deterioration. As with the other states, however, ESAL projections are used in pavement design.

Capacity improvement requirements

Capacity improvements in California fall under the STIP and are funded according to a formula-based allocation process. Formulas stipulate the following:

- 25 percent of available STIP funds are allocated to the ITIP
  - 10 percent for "flexible use" interregional projects
  - 2.25 percent for intercity rail
  - 12.75 percent for non-urban interregional roads
- 30 percent of STIP funds are allocated to Northern California counties
- 45 percent of STIP funds are allocated to Southern California counties.

Funds allocated to the counties (which account for three-quarters of all STIP funds) are distributed based on two weighted criteria: population, which is weighed 75 percent, and state highway mileage, which is weighed 25 percent. Given this formula, the selection of capacity investments is made primarily at the regional level, with little consideration of statewide travel demand issues.

Safety

Safety investments made through the SHOPP in California are based on a traffic safety index score. This score does not explicitly include a measure of travel demand. In addition, California also utilizes the practice of pre-positioning emergency response crews on high-volume highway segments during peak-period travel as a means of accelerating accident response and traffic flow restoration.

Trade-offs between preservation and capacity enhancement

STIP and SHOPP resources are allocated under distinct processes and are driven by eligibility of funding under various state and federal programs. As a result, there is no tradeoff analysis between investment alternatives within these two programs. For example, since SHOPP needs exceed available federal and state resources, all state and federal funds that are legally eligible for SHOPP programs are allocated to SHOPP. On the other hand, some federal (e.g., TE) and state (e.g., California Proposition 42 and Public Transportation Account spillover funds) are only eligible for STIP projects. In recent years, however, resources have been re-allocated from the STIP to meet California's non-transportation financial needs.

Performance measures and objectives

Caltrans has developed organizational and system performance measures to guide its operations and decisions related to transportation infrastructure and service provision. Organizational performance measures have been coupled with targets for improvement. Targets have not yet been set, however, for system performance measures (e.g., travel demand and congestion-related measures).

4.5 North Carolina DOT (NCDOT)

4.5.1 Organizational Structure of the State DOT

NCDOT is responsible for operating and maintaining over 75 percent of North Carolina's roadway miles, a far larger share of statewide highway miles than any of the other study participants. (Note: The other state DOTs maintain roughly 10 percent of their state's total center-line miles.) State law also requires that 90 percent of North Carolina residents have access to a four-lane, divided highway within five miles of their homes. Furthermore, recent and projected population growth rates in North Carolina are among the fastest in the nation. These characteristics make NCDOT a unique organization in that it must simultaneously address system preservation and capacity needs for an unusually large infrastructure network.

NCDOT's Transportation Planning Branch is responsible for a statewide long-range strategic plan, technical support for MPO models, and programming of capacity-related projects. Although districts and MPOs identify projects for capacity expansion, planning staff are also responsible for coordinating the process and providing technical assistance as projects move from identification to the programming stage. Next, projects are selected by the state Transportation Board in a programming process that involves resource negotiation among members, subject to financial constraints and legal requirements, and results in a STIP.

The long-range strategic plan was initiated by NCDOT leadership and has retained the support of upper management. Although carried out by the Planning Branch, the long-range plan involved numerous divisions of NCDOT, defined strategic goals and objectives, identified the various investment needs of the transportation system, and suggested courses for meeting the needs of the system (e.g., moving from capacity expansion toward preservation).

The Operations Branch includes an Asset Management staff that oversees bridge, pavement, equipment, roadside, and other maintenance units. Where the Transportation Planning Branch identifies capacity needs, the Operations Branch identifies system maintenance, preservation, and operations needs. Funding of maintenance, preservation, and operations needs occurs independently of the TIP process and comes directly from the state legislature.

4.5.2 Major Components of NCDOT's TAM Program

Legislative focus on expansion

Due to a legislative requirement to build out a pre-defined intrastate highway system, North Carolina has dedicated substantial funds to system expansion—significantly more than other states that participated in this study. Although the long-range plan suggests addressing more preservation needs, the high rate of population growth and policy considerations will continue to emphasize system expansion. The decision-making processes and programs that provide resources for capacity expansion, however, are balanced by realization of maintenance, operations, and preservation needs within the Asset Management division, as a result of data-driven analysis and relatively strong linkages among staff in asset management, planning, and other functional areas.

Asset management program focus on preservation

As noted earlier, NCDOT is responsible for more than 168,000 lane-miles statewide or more than three-quarters of the state's total center line miles and more than 17,000 bridges. Given the state legislation's requirement for ongoing build out of an extensive intrastate system combined with a program to pave dirt roads and the expansion of local roads by the state's developers, the number of road miles under NCDOT maintenance is expanding by more than 400 miles each year. Ongoing maintenance and preservation of this extended roadway network places significant demands on the state's budget and NCDOT's resources. Within this constrained environment, asset management processes have evolved as the optimal method for sustaining the existing roadway network.

TAM performance measures and standards

NCDOT is in the final stages of completing a multi-year process of developing performance measures and performance standards for each of the activity areas encompassed by the state's asset management program. These activities include maintenance, pavement, bridges, traffic/ITS, roadside, and construction. For each of these activity areas, NCDOT's TAM program has identified multiple asset specific performance measures, with over 100 difference performance measures and related performance targets identified in all. In accordance with the TAM program's emphasis on preservation, the selected performance measures are dominated by measures relating to system preservation, with relatively few measures relating to travel demand-related concerns. For example, the bridge unit includes measures such as "percentage of bridges exceeding the National Average" deficiency rating and "percentage of overhead sign structures rated 'good.'" The traffic/ITS unit includes several preservation related measures (e.g., "linear feet of pavement markings visible at night"), but also includes the indirect travel demand measure "incident clearance times." Only a small number of measures relate either directly or indirectly to travel demand issues. This is to be expected as travel demand is not a current focus of NCDOT's asset management program.

High-level support

Both the statewide long-range plan and the asset management program enjoy support at high levels of NCDOT. This high-level support and the identification of common goals and objectives at all levels of management is crucial to the long-term success of any asset management program.

"Baseline" asset management tools

As with each of the other study states, North Carolina employs pavement management, bridge management, and maintenance management systems for the ongoing maintenance of highway infrastructure.

Data Collection

NCDOT's TAM program, organizationally a part of the Bureau of Operations, has numerous data collection and management responsibilities. Much of this data is available to other DOT users and some data (e.g., pavement condition) are available to the general public as well.

Data maintained by NCDOT's TAM program include:

- *Inventory:* NCDOT's asset inventory includes pavements, bridges, and signals. NCDOT does not currently maintain an inventory of roadside items, such as signs and culverts, due to the "overwhelming" size of the system for which the Department is responsible.
- *Pavement:* Condition data for pavements are collected through annual inspections of the interstate network and biennial inspections of other roadways. Pavement inspections include a 100-percent survey of all flexible pavements and a sample of the first one-tenth mile of each mile for rigid pavements. Survey data are reported as distresses (PCR, ranging from 0 to 100), and are made available on the NCDOT web site for all internal and external users. PCR ratings are available for each of the last 15 survey years.
- *Bridges:* Condition data for bridges are collected through annual inspections.
- *Traffic/ITS:* Although the state does not currently inventory ITS devices, signals, signs, or pavement markings, this division is responsible for monitoring performance of such assets to inform the decision-making process.

System preservation decision processes

Like California, North Carolina's project selections occur primarily at a decentralized level, with the majority of analysis for project prioritization occurring inside of MPOs and regional planning agencies (RPAs). Further analysis occurs at NCDOT Regions before final resource negotiations among the statewide programmers. The decision-making process for inclusion in the STIP occurs at the MPO and district levels before analysis at the statewide level and ultimately the opinion of the Board of Transportation.

NCDOT does not require a standard procedure for analyzing and prioritizing travel demand-related needs within each region, in part because the goals of each region differ (e.g., mobility versus safety versus economic development). Much of the funding for preservation projects in North Carolina is derived from an annual legislative appropriation.

Capacity improvement decision processes

Capacity investments in North Carolina are a reflection of the state's legal requirements and the funds available that are specifically programmable only for new capacity. The processes used to identify which network components will receive resources first, however, are not currently based on explicit measures of travel demand or economic analyses, but rather on a scoring formula. The state allocates 25 percent of funds equally across all districts, 25 percent based on the number of intrastate system miles left to complete, and the remaining 50 percent based on district population (thereby implicitly considering travel demand).

Decision-support tools

NCDOT will soon unveil a new benefit-cost analysis tool that will inform the decisions of the Transportation Board's programming of capacity expansion projects. As in Utah, the tool is not intended to remove the resource allocation decision from human decision makers, but rather to provide Board members with additional, higher-quality, objective information that speaks to the varying performance goals of districts (e.g., mobility, economic development, and safety).

4.5.3 Travel Demand Measurement and Forecasting Capabilities

Current measures of travel demand

NCDOT's Bureau of Planning tracks current measures of travel demand through annual traffic counts along its primary highway network, semi-annual traffic counts along its secondary network, and counts within MPOs every two to three years. Traffic counts are recorded manually in a map book, which is one of NCDOT's highest-use products. Project-specific counts are also performed; these special counts include vehicle-type classifications, turning movements, and peak versus non-peak flows.

Travel demand forecasting

NCDOT currently does not produce a statewide travel demand model but does provide technical support to the regional models for small- and mid-size MPOs (there are 11 total MPOs in North Carolina). Travel demand forecasting capabilities are also used to support cost-effectiveness analyses for major investment projects.

4.5.4 Links Between TAM and Travel Demand Measures

Following are documented ways in which travel demand data are used by NCDOT to support asset management processes or where asset management processes are used to address future travel demand issues.

Roadway Wear

NCDOT does not currently use measures of travel demand to predict asset deterioration. As in other states, however, ESAL projections are used in pavement design.

Re-investment prioritization

Transportation investment prioritization occurs within each district in North Carolina, but ultimate authority to allocate resources resides with the state's Transportation Board. Resource allocation among divisions by the Board does not explicitly consider travel demand measures.

Capacity improvement requirements

Capacity investments in North Carolina are a reflection of the state's legal requirements and the funds available that are specifically programmable only for new capacity. The processes used to identify which network components will receive resources first, however, are not currently based on explicit measures of travel demand or economic analyses, but rather on a scoring formula. The state allocates 25 percent of funds equally across all districts, 25 percent based on the number of intrastate system miles left to complete, and the remaining 50 percent based on district population (thereby implicitly considering travel demand).

Safety

Travel demand measures are not explicitly considered in decision-making processes for safety projects. However, each NCDOT region has a unique goal relative to transportation investment (e.g., congestion relief, economic development, and safety enhancement). The mix of projects selected by a district reflects its interests—meaning that some districts may identify more safety-related improvements than others.

Trade-offs between preservation and capacity enhancement

Allocation of resources between preservation, capacity, and other needs in North Carolina is subject to legal requirements, as in other states; however, state law actually requires that certain funds be dedicated to expansion of the highway network. Management and preservation needs, on the other hand, are addressed through annual legislative appropriations based on historical trends and the needs identified by NCDOT staff.

Within this environment, NCDOT will soon unveil a new benefit-cost analysis tool that will provide decision makers on the Transportation Board with a complete picture of the benefits of all potential projects, including preservation- and capacity-oriented projects. This tool is expected to make use of VMTs or other travel demand-related measures to scale the size of investment-related travel time savings and other traveler-oriented benefits.

Performance measures and objectives

NCDOT uses performance measures in a variety of areas. For example, the traditional asset management functions (bridge, pavement, roadside, operations, etc.) each are in the process of refining numerous performance measures that ultimately will be used to guide investment within each particular area. Broader performance measures are discussed in the statewide long-range transportation plan, including those related to travel demand management and congestion and efficiency. However, no targets are used as part of a process to help identify specific investment needs.

4.6 Summary

Linkages between TAM and travel demand vary from state to state, but largely remain formative. Travel demand data are occasionally used explicitly to inform TAM analyses (e.g., determining benefits of preservation projects based on VMT), but are mostly considered implicitly (e.g., using population growth in decision-support tools to determine resource allocation). Specifically, this review observed the following:

Current and projected travel demand measures as inputs to the TAM process

- **Roadway wear:** While current travel demand measures are frequently captured *implicitly* by agency asset management needs analyses (e.g., through annual segment-by-segment roadway condition evaluations), these measures are rarely incorporated *explicitly* into analyses of infrastructure deterioration rates or the subsequent maintenance and rehabilitation requirements.
- **Investment prioritization:** Only one of the four study states (Utah) has developed a decision support tool that uses travel demand-driven investment benefits to help prioritize short-term preservation investments between locations or regions.
- **Project benefit-cost and alternatives analysis:** Virtually all of the participant states regularly incorporate travel demand measures when conducting benefit-cost analyses (or other cost-effectiveness assessments) of proposed major investment projects and their investment alternatives

Using the TAM process to address issues related to travel demand

- **Capacity improvements:** Two of the four participant states (Michigan and California) maintain statewide travel demand models and one (Michigan) maintains a truck model. These tools are critical to the objective and consistent identification of those travel corridors expected to suffer most from travel demand growth and hence having the highest priority investment needs.
- **Trade-off analysis between preservation and capacity needs:** None of the four states interviewed has yet succeeded in developing an objective and comprehensive process or a decision support tool to optimize the allocation of funds across multiple investment uses (e.g., preservation, capacity improvements, safety, and beautification). They recognize that doing so will require the use of forecast travel demand measures to compare investment benefits.
- **Objectives and performance measures:** The current goals and objectives of the participant states' TAM programs reflect the current focus of these programs (i.e., maintenance and preservation) and hence place little emphasis on travel demand-related concerns (e.g., congestion). In contrast, the agency goals and objectives tend to be broader in scope and typically include the maintenance and improvement of mobility as a key goal.

TAM program focus

The TAM programs for each of the four participant states remain primarily focused on system maintenance and preservation. This focus reflects the history of each program's development (developing from a kernel of pavement and bridge management systems) and the particular investment needs, legislative requirements, and "color of money" limitations within each state. Moreover, most agencies tend to focus on the short- to medium-term investment needs, but place less emphasis on long-term objectives (e.g., mitigating congestion). This emphasis is reflected in their TAM program goals and objectives, which are also primarily focused on maintenance and preservation.

A key process currently used by agencies (either within or outside of their existing TAM programs) to consider and address long-term issues driven by ongoing growth in travel demand is the SLRP. The next chapter considers the current SLRPs of the four participant states, with emphasis on what these documents reveal about each state's plans to address the consequences ongoing travel demand growth. In addition, the chapter also considers how states are preparing long-term budgets to meet all transportation investment needs.

Chapter 5. Relationships Between Asset Management, Long-Range Planning, Long-Range Budgeting, And Travel Demand

5.1 Introduction

In many respects, the process of designing and preparing an SLRP encompasses many of the primary components of the TAM process (see Exhibit 5-1) and then encapsulates the results within the confines of a single document. Specifically, most long-range plans include most, if not all, of the following asset management-related processes:

- Identification of long-range vision, goals, and objectives
- Evaluation of current condition and performance
- Identification of preferred investment strategies to attain desired outcomes
- Evaluation of total investment needs
- Budget allocation and project prioritization
- Performance monitoring

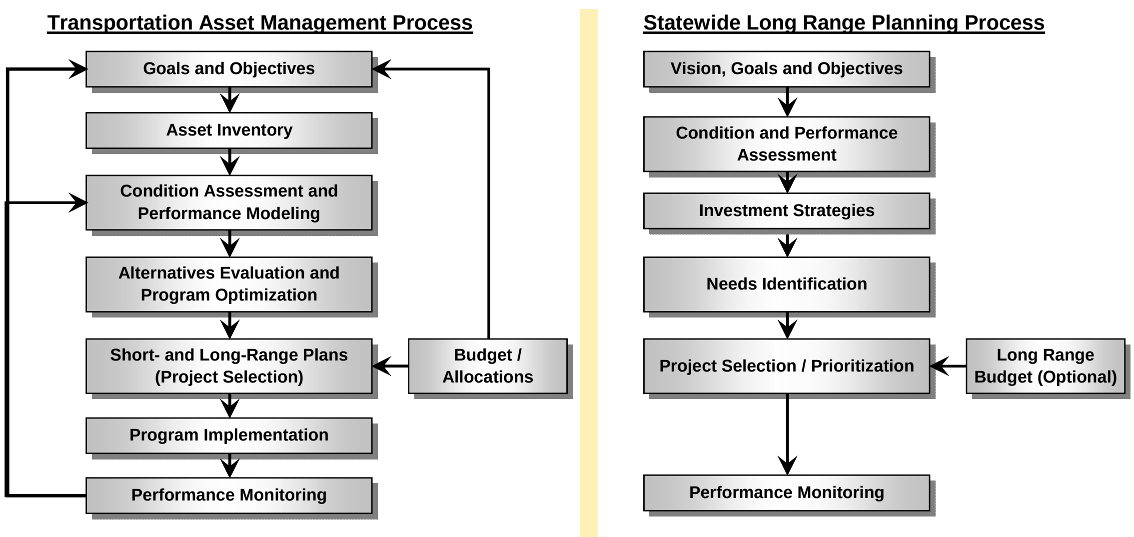


Exhibit 5-1: Similarities between TAM and SLRP processes

More than just paralleling the overall asset management process, long-range transportation plans and their accompanying budget analyses should ultimately be viewed as key and active components in the asset management process. Long-range plans and budgets are obviously of limited value if their objectives and strategies are not tightly coordinated with an agency's asset management process. Rather, a comprehensive long-range plan should serve as a key reference material or "road map" documenting the goals, objectives, strategies, and financial constraints of the overall asset management program. This document should also help agencies conduct a strategic analysis of their preferred allocation of funding across maintenance, preservation, capacity improvement, and other investment needs—a key asset management function.

This chapter reviews the SLRPs and related long-term budgets of each of the four study states. Specifically, the review documents the aspects of each state's long-range plan as it relates to asset management processes and objectives. Consistent with the goals of this study, this review will place emphasis on how the sample agencies are planning for future travel demand and preparing long-term budgets.

5.1.1 Background

The asset management programs studied do not perform strategic analyses consistent with the time frames considered in the SLRPs. As discussed above, many existing asset management programs are primarily focused on short-term issues (e.g., within the next 5- or 10-year period), with less focus on the longer-term period (i.e., 20-plus years) covered by the SLRP. Moreover, the DOT divisions responsible for production of long-range plans (usually within the planning department) are often independent of those departments or staff responsible for asset management (although asset management staff can and do contribute to SLRP production). For these reasons, the following analyses of each state's SLRP within the context of asset management principles should not be viewed as a review of the long-term component of each state's "official" asset management program. **Rather, in the absence of explicit, long-term asset management processes, the SLRP provides an official statement of each state's long-term transportation goals, objectives, strategies, needs, and expected financial capacity.** In this sense, the SLRP is considered to be at least an *implicit* component of each state's existing asset management programs and as such provides valuable insights into the state's intended long-term vision and strategies.

5.2 Long-Range Goals and Objectives

As outlined in Exhibit 5-1, the identification of clear policy goals and objectives represents a key foundation to a successful asset management program. While some goals and objectives may address short-term issues, *strategic* asset management requires identification of *long-term* goals and objectives as required to attain desired *long-term* outcomes. Moreover, these long-term goals and objectives must be consistent with and support each DOT's mission statement.

Similarly, the SLRP development process also includes the identification of clear goals and objectives as a means to help identify preferred investment strategies and to guide future resource allocation. Moreover, as a key strategic document, SLRPs have both the input and endorsement of top agency staff. Following are descriptions of the statewide long-range planning goals and objectives of the four state DOTs participating in this study and their relation to long-term travel demand needs.

5.2.1 California

The goals and objectives of Caltrans' current SLRP, *California Transportation Plan 2025*, reflect the input of diverse stakeholder groups including extensive public input through household surveys and outreach sessions. The plan's goals and objectives are also intended to reflect the goals and objectives of the Governor's *Go California* initiative, a program designed to decrease congestion, improve travel times, and increase safety, while accommodating future

> *Caltrans vision statement: "California has a safe, sustainable, world-class transportation system that provides for the mobility and accessibility of people, goods, services, and information through an integrated, multimodal network that is developed through collaboration and achieves a prosperous economy, a quality environment, and social equity."*

population and economic growth. *Go California*, now part of the Governor's Strategic Growth Plan, is an ambitious 10-year effort to invest in the state's transportation infrastructure. Specifically, Caltrans' current SLRP identifies the following transportation goals:

- Enhance Public Safety and Security
- Preserve the Transportation System
- Improve Mobility and Accessibility
- Maximize Efficient Use of Resources
- Reflect Community and Environmental Values

Long-Term Objectives Relating to Travel Demand

The detailed definitions for these goals make specific reference to several travel demand- and congestion-related objectives. These include the following objectives by goal:

- Enhance Public Safety and Security
  - Improve pre-incident preparedness and post-incident recovery (to mitigate congestion)
- Improve Mobility and Accessibility
  - Increase capacity of all modes such as adding more lane-miles and expanding transit service areas and hours
  - Promote the use of advanced communications, such as teleconferencing, electronic shopping, and government, to increase accessibility and reduce the need for physical travel
- Maximize Efficient Use of Resources
  - Reduce congestion and demand by promoting a shift to environmentally preferable transportation solutions such as pedestrian travel, bicycling, mass transit, and virtual travel.

5.2.2 Michigan

MDOT's vision statement: "Michigan will lead the 21st century transportation revolution as it led innovation in the 20th century. We will move people and goods with a safe, integrated and efficient transportation system that embraces all modes, is equitably and adequately funded, and socially and environmentally responsible".

MDOT is in the process of updating its SLRP (for the period 2005 to 2030) and is currently seeking input from a broad range of stakeholder groups to help establish the new plan's goals and objectives. Specifically, these stakeholders include households, regional planning agencies and councils of governments, chambers of commerce, environmental groups, state agencies, and an appointed economic advisory council (which includes representatives of industry, academia, and all levels of government). While the specific goals and objectives of the 2005-2030 plan have yet to be fully identified, the plan will represent an updated and refined version of the predecessor, 2000-2025 SLRP (developed using a similar process). The 2000-2025 SLRP identified the following transportation goals:

- Preservation
- Safety

- Basic mobility
- Economic growth
- Transportation services coordination
- Intermodalism
- Environmental protection and aesthetics
- Land use coordination

Long-Term Objectives Relating to Travel Demand

The 2000-2025 SLRP provides detailed definitions of each of the broad transportation goals identified above. These detailed definitions provide a general outline of desired plan outcomes, but do not make specific reference to travel demand, freight movement, congestion, travel delay, or related objectives. They do, however, provide some *indirect* reference to these objectives through their emphasis on the promotion of transportation system efficiency and economic development. For the Michigan SLRP, explicit consideration of travel demand, congestion, and related issues are more directly considered in the plan's strategies.

5.2.3 North Carolina

North Carolina's current *Long-Range Statewide Multimodal Transportation Plan* represents a bold departure from the state's prior long-range planning efforts. Based on the direction and leadership of the state's governor and Secretary of Transportation, NCDOT worked to develop a long-range plan that better defines the state's long-range goals and objectives as compared to prior plans. Moreover, the clear support of DOT upper management combined with improvements in the quality of the SLRPs supporting analyses (originating in part from the asset management program) has helped NCDOT better focus its internal resources on desired objectives and is also having a positive influence on the state's project prioritization process.

In addition to guidance from the governor and Secretary of Transportation, development of the current SLRP and its goals and objectives incorporates input from the NCDOT Board of Transportation, NCDOT Board of Transportation Planning Committee, a plan Steering Committee, other state departments (e.g., commerce, environment, and natural resources), and the public through outreach meetings. Specifically, NCDOT's current SLRP identifies the following transportation goals:

- Mobility
- System maintenance and preservation
- Economic development and efficiency
- Safety
- Efficient and balanced growth
- Modal options and intermodal efficiency
- Fiscal and environmental stewardship
- Coordination with transportation stakeholders

Long-Term Objectives Relating to Travel Demand

The detailed definitions for these goals make specific reference to several travel demand and related objectives. These include the following:

- Mobility:
  - Reduce bottlenecks, congestion, and travel time
  - Increase system efficiency through existing, new, and emerging technologies
- Economic Development and Efficiency:
  - Provide improvements that increase system efficiency
- Modal Options and Intermodal Efficiency:
  - Promote demand-management services in areas of high travel demand and potential
  - Provide the appropriate infrastructure to encourage intermodal transfers for personal travel

5.2.4 Utah

UDOT's vision statement: "We will provide 'Effective/Efficient roadway maintenance through quality leadership and interaction with our partners/customers and team members.'"

Utah's current SLRP is called *Utah Transportation 2030*. Selection of the goals and overall development objectives for the 2030 plan reflect input from multiple stakeholder groups including the Utah Transportation Commission, UDOT's Executive Director, the Planning team, and the Department's consultant team. This document also reflects considerable input obtained through statewide public outreach sessions (conducted via the Internet and through "town hall" meetings). Utah's current SLRP was developed using the following four strategic goals:

- Take care of what we have
- Make it work better
- Improve safety
- Increase capacity

Long-Term Objectives Relating to Travel Demand

The detailed definitions for these goals make specific reference to several travel demand and related objectives. These include the following:

- Make it work better:
  - Make system improvements that can improve capacity
  - Partner with other transportation agencies to meet transportation demand
- Increase capacity through:
  - Travel Demand Management (TDM)
  - ITS
  - Access management
  - Additional lanes

5.3 Current and Projected Conditions and Performance

Most SLRPs also document the current condition and performance of a state's highway network and other transportation modes as well as current and expected future transportation trends. This analysis is intended to provide a baseline evaluation of current issues and support the identification of preferred plan investment strategies.

The current SLRPs for each of the four study states include evaluations of current system condition and performance for each state. The following state-by-state descriptions focus solely on performance assessments relating to highway travel demand (both auto and truck), with emphasis on those travel demand issues the plan is intended to address via specific investment strategies.

5.3.1 California

California's *Transportation Plan 2025* provides a summary of the projected increases in travel demand across all modes statewide over the period 2000-2025. This includes discussion of the projected increase in highway VMTs and congestion. The assessment also includes discussion of the projected increase in traffic through the state's large seaports and the implications for highway improvements as required to support related growth in the state's truck traffic volumes.

The plan also cites several of the underlying factors driving the growth in auto travel demand. These include increasing separation between home and work locations, increasing non-work VMTs (reflecting increased separation between home and non-work destinations), and increasing population. Each of these and other related factors yield a subsequent increase in congestion on all roadway types. Without the benefit of comprehensive statewide travel demand and truck demand models, the plan does not provide specifics on the magnitudes and locations of the major increases in travel demand within the state's roadway network. Caltrans is working to improve the quality of its statewide travel demand forecasting capabilities to better support these long-term strategic assessments.

5.3.2 Michigan

Michigan's current SLRP documents both the current level of congestion on state-controlled highways and the projected worsening of congestion over time. For example, as of 2000, roughly 13 percent of the state's maintained roadways were characterized as LOS F. By 2025, the percentage of roads LOS F is projected to increase to 17 percent. Contributing to this trend of deteriorating service is a projected increase in VMTs of 24 percent between 2000 and 2025 (see Exhibit 5-2). By 2025, the projected number of VMTs under congested conditions is projected to increase by 67 percent, by which time one in five miles traveled on state highways will be in congested conditions. The SLRP recognizes that this growing congestion is the result of ongoing growth pushing against zero or minimal growth in capacity.

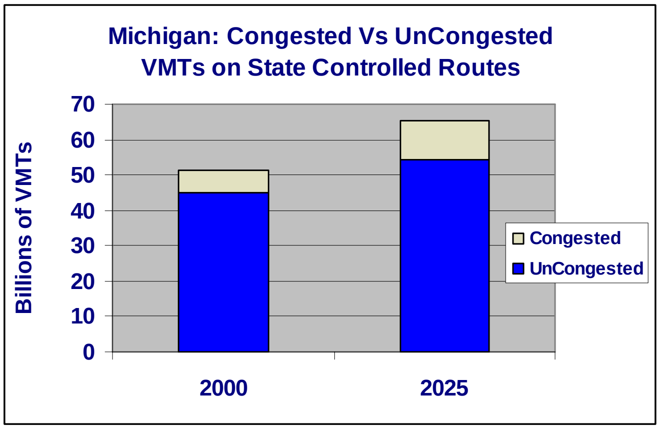


Exhibit 5-2: Michigan Congested vs. Un-congested VMTs on State-controlled Routes

Similarly, the state's truck analysis capabilities and truck travel demand model support valuable analysis of both the magnitude and locations of recent and expected future commercial vehicle traffic growth. Based on this analysis, it is clear that the growth in commercial vehicle miles of travel (CVMT) has clearly outpaced auto VMT, thus helping to prioritize specific problems that need to be addressed by the plan. For example, over the period 1990 to 2000, auto VMT increased by 20 percent, whereas CVMT increased by more than 190 percent. This increase was driven in part by NAFTA (and the subsequent increase in traffic between Michigan and Ontario, Canada) and the adoption of just-in-time delivery practices in Michigan's manufacturing sector.

A clear strength of Michigan's assessment of current conditions and performance and future needs is the ability of the state's travel demand and truck models to evaluate future conditions within specific travel corridors. This allows the state to think strategically about where to focus long-term preservation and capacity investment funds. Other states could similarly benefit from the development of statewide travel demand and truck travel models.

5.3.3 North Carolina

North Carolina's *Long-Range Statewide Multimodal Transportation Plan* provides a concise description of historic and projected population growth. The plan also cites a 10-year increase in VMTs of nearly 40 percent over the decade between 1990 and 2000, but does not indicate the expected future rate of growth in VMTs or congested travel, or offer specificity about the location. Similarly, the plan recognizes the need to support expected increases in commercial vehicle traffic (both through and to/from the state) as a means of supporting the state's continued economic growth and that of the nation. However, without an existing truck travel demand model, the plan does not contain estimates of the projected increase in truck VMTs or the routes most likely to be impacted. The state is planning development of a truck travel model to meet this need.

5.3.4 Utah

The conditions and performance sections of Utah's *Transportation 2030* SLRP focus primarily on the issue of projected growth in the state's population, with emphasis on the geographic disparity in the rates of population growth (i.e., with the vast majority of growth concentrated in the I-15 corridor centered around Salt Lake City). The plan then goes on to recognize the subsequent expected impact on travel demand, but without providing specific numeric analyses. The absence of projected increases in travel demand and congestion overall may reflect the absence of a statewide travel demand model. Similarly, UDOT's SLRP does not provide an assessment of projected CVMT growth. To help meet this need, UDOT is also planning development of a truck travel demand model.

5.3.5 Summary

System condition and performance analyses offer an important opportunity to assess the current characteristics of a state's highway infrastructure and its anticipated future condition and performance as well. With respect to the principles of asset management, the ability to forecast the magnitude of future travel demand (both auto and truck) within specific travel corridors provides critical information for the evaluation and prioritization of long-term investment needs. Each of the participants in this study has recognized that need and are either refining existing travel demand tools or planning development of new tools intended to better support this need.

5.4 Identification of Investment Strategies

Transportation investment strategies are designed to address the goals and objectives in light of the transportation system's current and projected condition and performance. This section reviews the strategies identified within each of the study state's SLRPs intended specifically to address travel demand-related problems, most notably congestion.

5.4.1 California

California's SLRP asserts that the state cannot address projected growth in highway travel demand and the subsequent increases in congestion through increases in highway capacity alone. This is a result of environmental, physical, and fiscal limitations. Rather, the state's SLRP focuses on a mix of supply side (i.e., capacity), system management, and TDM investments as the best means to mitigate further increases in congestion. System management investments are operational and ITS improvements intended to enhance the efficiency of the existing highway infrastructure. TDM strategies under consideration are intended to alter a traveler's behavior in terms of the timing, route, destination, or mode selected for a trip or the need for travel in the first place. The following are key investment strategies from the 2025 SLRP related to travel demand.

System Management Strategies

- Improve the operating efficiency, system management, and connectivity of California's transportation system using advanced transportation applications
- Continue to support and expand freeway service patrols to rapidly respond to incidents and restore traffic flow

TDM Strategies

- Provide greater access to information, products, and services without the need for physical travel

- Increase use of telecommuting, e-commerce, and e-government services
- Enhance connectivity between transportation modes
- Enable travelers to better manage their individual trips through better real-time traveler information (e.g., on modal options, travel times, costs)

System Capacity Improvement Strategies

- Expand existing and develop additional roadways
  - Add lanes and roads where feasible and determined to be the best alternative
  - Redesign and modernize interchanges to reduce or eliminate bottlenecks or restraints to smooth traffic flow, and to reflect current traffic-flow patterns
  - Increase capacity on major arterial streets through improved design, grade separation, signal timing, and other innovative solutions
  - Complete the HOV network and supporting facilities
- Expand and improve transit services
  - Expand dedicated guideway, bus rapid transit service and facilities, smart shuttles, and shared car programs where proven effective
  - Improve multimodal ground access to airports, including intercity bus service connecting small urban and rural communities to passenger air service
- Use technology to make vehicles “smarter”
  - Allow more vehicles to safely share the road through advanced vehicle control and guidance systems
  - Improve bus design and fare systems to more quickly move people in and out of vehicles for increased efficiency

5.4.2 Michigan

MDOT’s 2000-2025 SLRP identified three strategies the state considered essential to attaining the long-range goals for the state’s system of freeways, highways, and bridges. These strategies are:

- Continue implementation of an asset management process
- Focus investment on the corridors of highest significance
- Manage congestion

Each of these strategies is addressed in turn as they relate to travel demand.

Asset Management

The plan’s description of asset management-driven investment strategies makes specific mention of the following strategies relating to travel demand:

- *Bridges:* Improvements to bridge widths to accommodate projected traffic volume increases, with emphasis on bridges with few alternative routes

- *Truck:* Implement new pavement and bridge design standards to accommodate changes in truck volumes, sizes, and weights

Corridors of Highest Significance

Investments in "corridors of highest significance" recognize that some travel corridors carry higher volumes of goods, services, and people than others. Therefore, investments in the corridors should be prioritized. Specifically, MDOT uses the following factors to select and rank these corridors, each of which relates either directly or indirectly to auto or freight travel demand:

- Total and commercial average daily traffic (ADT)
- International trade
- Total population and population density
- Total employment and employment density
- Tourism and convention centers
- Air carrier and general aviation airports
- Cargo port
- Carpool parking lots
- Intercity bus service
- Intermodal freight and passenger terminals
- Passenger and freight rail
- LOS E or F (congestion).

The identification and analysis of corridors of highest significance (including input from the state's travel demand models) allows MDOT to determine both the locations of highest need for capacity improvements as well as the severity of the problem to be addressed. In addition to identifying the need for roadway widening along specific state roadway segments, this investment strategy has also targeted several border crossings between the U.S. and Canada "of highest significance" in need of both capacity improvements and the introduction of operational efficiencies such as ITS investments (i.e., to ensure efficiency in the movement of goods and people across the Canadian border).

Congestion Management

Congestion management strategies cover a range of investments beyond those relating to bridge widening or investments in corridors of highest significance. Travel demand-related congestion management investment strategies include:

- Freeway Modernization:
  - Roadway straightening
  - ITS investments in real-time traveler information, video monitoring of incidents, and ramp metering to help maintain/improve traffic flow

- Access Management:
  - Coordinated planning between MDOT and local agencies designed to provide or manage access to land development while simultaneously preserving traffic flow on surrounding road systems
- Interchange Strategy:
  - Improvements to existing interchanges and construction of new interchanges in response to increasing traffic volumes
- Car Pool Parking Lots:
  - Facilitating ridesharing to reduce both congestion and parking demand
- Land Use Strategy:
  - Working with local agencies to provide or manage access to new land development while simultaneously preserving existing traffic flow

5.4.3 North Carolina

North Carolina's current SLRP does not identify specific investment strategies to address current and projected future condition and performance levels. Rather, the plan focuses on its projected investment needs, which are assumed to implicitly reflect NCDOT's investment strategies. These investments cover:

- Highways and bridges:
  - Including backlog and ongoing maintenance, preservation, modernization, and expansion needs
- ITS investments:
  - Traffic Management: Real-time adjustments to traffic control systems in response to changing conditions
  - Emergency Management: Systems that improve the response time and effectiveness of emergency responders
  - Information Management: Applications that improve real-time communication with system users
  - Commercial Vehicle Operations: Applications that streamline and automate trucking enforcement

5.4.4 Utah

Similar to California's plan, UDOT's SLRP identifies a mix of capacity, operational, and TDM improvements as the best means to address Utah's current and projected travel demand concerns.

Increase Capacity

With the rate of population growth projected to continue, UDOT plans to continue to add new routes, widen existing corridors, construct new interchanges, and perform other work to increase capacity. Most of the anticipated need for capacity-increasing projects falls within the urbanized areas along the Wasatch Front (I-15 corridor), Cache County, and Washington County.

Operational Improvement Strategies

UDOT's operational strategies are designed to maintain or improve current performance of the existing highway system. Specific strategies being considered include:

- Continuation of incident management programs to reduce delays
- Improved signal coordination to optimize traffic flows
- Installation of freeway ramp meters to protect mainline capacity, where appropriate
- Implementation and maintenance of a comprehensive access management program to protect the existing highway system's carrying capacity
- Continuation of research of the effectiveness and feasibility of managed lanes on freeways and primary arterial highways

Transportation Demand Management

TDM-related strategies are intended to address UDOT's goals of "making the system work better" and "increasing capacity." TDM strategies aim to reduce vehicle travel by providing alternatives that meet travel demand needs. Strategies include flexible work hours, vanpools, teleconferencing, transit use, and promoting walkable communities. Additional TDM strategies identified for consideration include:

- Supporting, maintaining, and expanding the Commuter Link traveler information system
- Expanding the highway system
- Enhancing and expanding the use of ITS
- Expanding transit services
- Providing better pedestrian accessibility and designing walkable communities
- Planning and constructing bicycle networks
- Constructing Park-and-Ride facilities and intermodal hubs
- Providing employer incentives for alternative commute modes and telecommuting, teleconferencing, and flexible work hours
- Increasing on-line commerce, services, and permitting
- Making system operational improvements
- Ridesharing and van pooling

5.5 Long-Term Investment Needs and Budgeting

Using their investment strategies as guides, the SLRPs for each of the four states next identify a range of investment needs intended to support their goals and objectives. This includes investments in preservation, modernization, operational improvements, expansion, and safety. At this point, the analysis is typically unconstrained and the investments are not prioritized.

The next step is to prioritize investments to reflect known or projected funding capacity.[13] In support of this capacity analysis, each of the study states has conducted an analysis of current funding streams. In addition, Michigan, North Carolina, and Utah have projected current funding capacity into the future and prepared long-term budgeting analyses to assess future funding capacity relative to needs.

This section considers how each of the four study states evaluates its long-term investment and operating needs, how each constructs budgets to support those needs, and how each addresses any remaining funding gap. It is important to consider here that the state's primary objective in preparing these long-range needs estimates and related budget analyses is to complete the SLRP; this study was unable to identify an internal DOT audience for long-range budget information beyond the SLRP. Specifically, interviewees stated that there was no process for regularly reporting this information beyond the SLRP and, at present, upper DOT management do not commonly request it.

5.5.1 Long-Term Investment Needs

The processes used by the four study states to place a dollar value on unconstrained, long-term investment needs is fairly rudimentary and similar across the four states.
The following is a listing of the approaches taken by these states.

Preservation

The four states interviewed typically use a mix of approaches to evaluate long-term preservation needs. These approaches included the following:

- *Analytical tools and methods:* States obtain backlog, current, and future needs estimates from pavement management, bridge management, and other decision support tools (e.g., RQFS, PONTIS, dTIMS). They may also perform "one-off" spreadsheet analyses to assess the needs of a specific asset type, with emphasis on those assets (e.g., guardrails or drainage) that may not be accounted for in their existing decision support tools.
- *Engineering assessments:* Regional/district engineering staff provide their evaluation of investment needs as required to address the investment backlog, current needs, and anticipated future needs. These estimates represent the "best estimates" of staff in the field who are most familiar with existing infrastructure and its condition and performance.
- *Consolidated analyses:* The states frequently combine input from the two sources above (i.e., engineering and analytical tools) to develop "consensus" estimates of backlog and current

[13] As documented elsewhere in this report, analysis and project prioritization in most states begins at the regional/district levels prior to statewide analysis and prioritization.

period needs. Note that these two approaches offer differing strengths. Analytic tools tend to provide a more consistent analysis (i.e., across asset types and regions) than do engineering estimates performed by different engineering staff in dispersed locations. In contrast, analytic tools have no means of identifying special regional needs, which are often better identified by on-site staff (e.g., a recently failed structure). Many state representatives suggested that they prefer to rely on information from both sources when evaluating short-term needs, but intend to rely more on analytic approaches for longer-term needs.

Capacity expansion, operational, and other improvements

Beyond preservation, most other investment needs, including those for capacity expansion, are identified by staff working in the state's regional offices using traditional engineering methods. As discussed elsewhere in this report, the funding limitations and legislative requirements of the study states (most notably Michigan, California, and Utah) place strict constraints on the eventual project prioritization for capacity. Key exceptions here include the output of analyses such as Michigan's "Corridors of Highest Significance" process, which provides a valuable, analytic method of evaluating long-term capacity needs.

5.5.2 Long-Range Budgeting

A key objective of this study is to review the processes used by state DOTs in preparing their long-range budgets. This section reviews the long-range budgeting practices of each of the four sample states. In each case, long-range budgeting is performed as part of the regulatory fulfillment of the SLRP.

In principle, long-range budgeting should consider all sources and uses of capital and operating funds over an extended time horizon (e.g., 20 to 25 years). Capital needs should reflect both the ongoing preservation and improvement requirements of the existing transportation infrastructure and requirements for capacity expansion and operational improvements. Operating costs should reflect the current and expected growth in resource needs (e.g., staffing, materials, equipment) as required to effectively maintain an expanding network of highway, transit, and other transportation infrastructure. On the revenue side, the analysis should effectively apply analysis of economic growth, travel demand, and other tax base drivers to project future growth in dedicated tax revenues (e.g., fuel tax, registration and licensing fees, tolls) while utilizing reasonable assumptions regarding future levels of local, state, and federal funding. Finally, given the long time horizon, the analysis needs to incorporate the effects of inflation and provide for long-term uncertainties (in the form of contingencies and cumulative surpluses).

In practice, the long-range budgeting processes utilized by state DOTs are somewhat rudimentary and have the primary objective of supporting preparation of the SLRP. As noted above, the DOTs interviewed for this study have no regular "market" for long-range budget analysis beyond production of the SLRP (this information is not included in any regular reports to upper management). Moreover, unlike MPO long-range plans, SLRPs are not required to be financially-constrained (that is, demonstrate the likelihood that funds will be available to cover all proposed projects). Hence, the existing budget analysis within each of the study state's SLRPs represents their own efforts to generate a more comprehensive analysis and more informative document. These analyses are not required to meet any reporting requirements standards.

To further emphasize this point, Exhibit 5-3 reproduces a chart from FHWA's 2002 report entitled *Evaluation of Statewide Long-Range Transportation Plans*. This report reviewed the then-current SLRPs of 48 U.S. states, including the contents of their financial planning components. Roughly 60 percent of the plans analyzed included some form of revenue analysis, 50 percent identified the amount and sources of expenses, while fewer than 30 percent completed a funding gap analysis. Based on these results (and analysis from state DOT site visits), it is clear that states are not preparing a comprehensive cash-flow analysis of sources and uses of funds as described above. Rather, the practice of conducting comprehensive long-term budgeting is not universal.

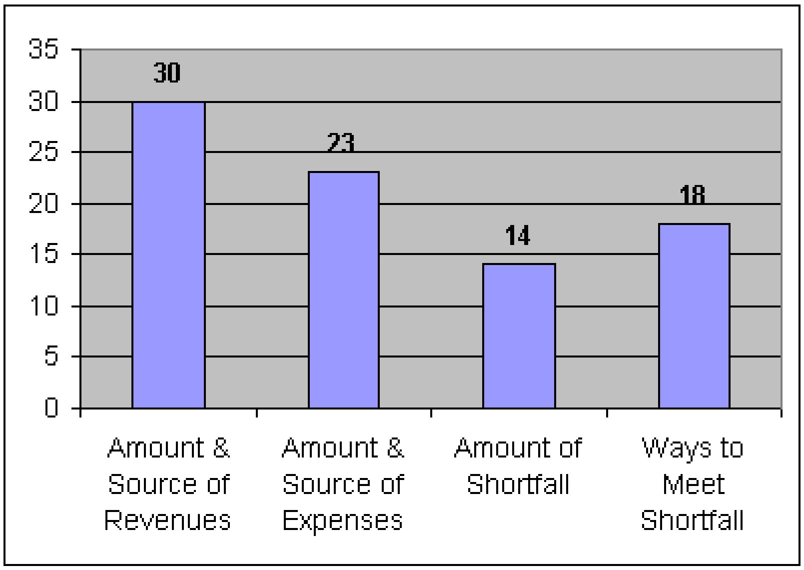


Exhibit 5-3: Number of SLRPs containing various pieces of information

5.5.3 California

California's current SLRP provides a detailed analysis of recent and historical funding levels for each of its primary revenue sources through 2000 (including fuel taxes, truck weight fees, and local sales taxes). However, the plan does not similarly provide a projection of the expected future revenues from these sources and does not compare expected revenues with the roughly $40 billion in investment needs identified by the plan.

Rather, the plan emphasizes the challenges inherent in developing reliable, meaningful long-range forecasts of future funding levels and notes that revenues are highly sensitive to changes in inflation, fuel prices, and economic and budgetary conditions, as well as future legislative actions at the state and federal levels. Moreover, "in the face of the many unknowns and the uncertainty that could affect future funding levels available to the State and regional agencies, the *California Transportation Plan 2025* recommends that a study be authorized to determine the reliability and viability of future transportation financing streams."

California has also produced the *Governor's Strategic Growth Plan*, which is a comprehensive transportation package designed to decrease congestion, improve travel times, and preserve and enhance the state's existing transportation networks. The plan calls for deployment of demand-management strategies and construction of new capacity to increase "throughput" in the transportation system. This plan will accommodate the transportation needs from growth in the population and the economy while reducing congestion. The plan also proposes public-private partnerships for joint ventures with the private sector to leverage public resources.

5.5.4 Michigan

MDOT's 2000-2025 SLRP is a partially financially constrained document (identifying both constrained and unconstrained investment needs) that contains comprehensive descriptions of the state's existing funding sources, existing funding capacity, and projected funding shortfall. The plan also includes discussion of potential future funding sources and increased tax rates for some existing sources. The underlying budgeting analysis relies on straight-line assumptions regarding the anticipated rate of growth in capital costs, state transportation revenues, and state and federal discretionary funds. Finally, the plan also provides both a financially constrained investment plan and a funding "gap" analysis indicating the volume of projects that cannot likely be addressed with reasonably projected funding capacity.

MDOT's Revenue Projections

The state of Michigan collects revenues from a variety of transportation-related revenue sources including fuel taxes, vehicle registration fees, auto-related sales taxes, title fees, license transfer fees, and interest. These tax revenues are deposited in the Michigan Transportation Fund (MTF) and then distributed among MDOT, counties, municipalities, and the state's mass transit operators. As with all state DOTs, MDOT also receives funds from federal-aid sources including those for Interstate Maintenance, National Highway System, Surface Transportation Program, Bridge Replacement and Rehabilitation, etc.

Using conservative assumptions regarding the real rate growth in funds from these sources, MDOT is projecting the availability of roughly $34 billion in highway revenue over the period 2003 to 2025, including $27 billion for road and bridge capital projects and $7 billion for routine capital maintenance.[14] These figures are in 2003 dollars. To estimate escalated dollars, the plan assumes an average annual growth in revenues from these sources of 2.2 percent based on recent historical experience within the fund. Project capital costs are assumed to increase at roughly 3.5 percent annually. Note that the assumption of a higher rate of increase for project costs provides for a conservative financial projection and hence is generally considered sound financial planning.

Gap Analysis

MDOT's current SLRP identifies total "funded" investments of roughly $34 billion ($2003), an amount equal to the projected available revenues expressed in $2003. By definition, this

[14] Real growth captures the growth in the underlying tax base for tax revenues feeding into the MTF (e.g., the rate of growth in fuel consumption driving fuel tax revenues), but excludes the impact of inflation.

constrained plan leaves a variety of projects unfunded, with the annual gap between funding capacity and identified investment needs anticipated to increase from roughly $500 million in 2003 to more than $2 billion by 2025. This increasing funding gap is depicted in Exhibit 5-4.

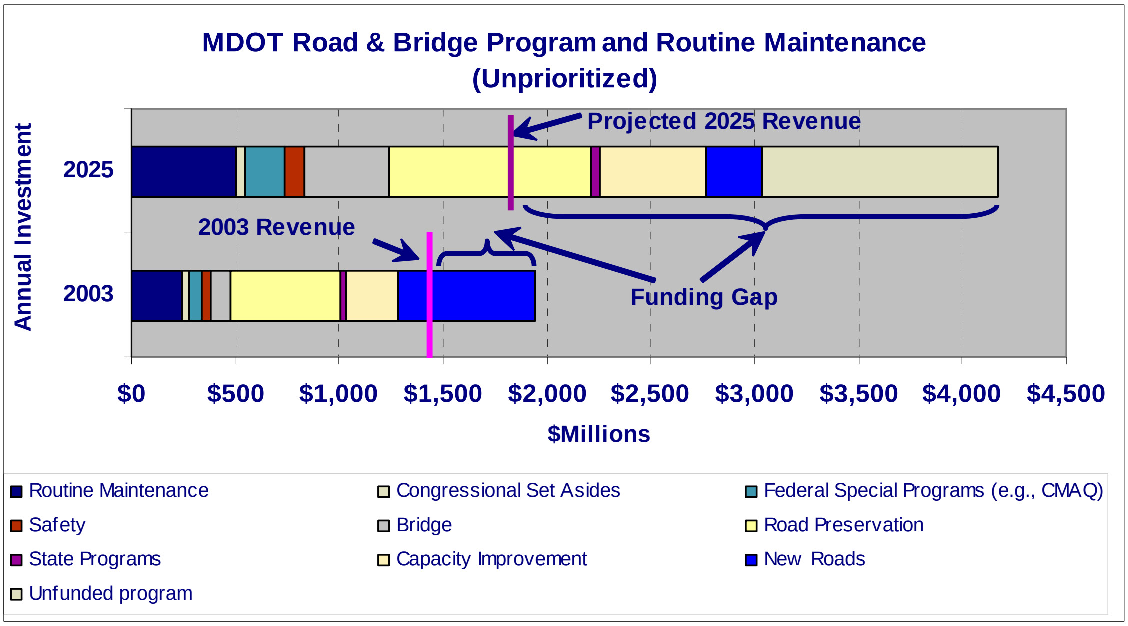


Exhibit 5-4: MDOT road, bridge and routine maintenance program (un-prioritized)

Alternative Funding Sources

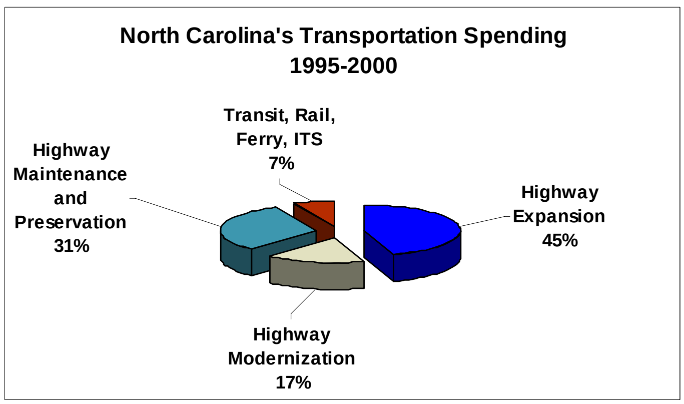
Having identified a significant funding gap, MDOT has also worked to identify a range of potential additional funding sources to augment existing state and federal funds. However, while the state is working to identify potential new sources of funds, the state recognizes that these sources take time to develop and few potential sources are actually realized. Hence, these potential funds have not been included in any budget projections. Here again, the process of identifying potential sources represents sound financial practice.

Potential sources that have been considered include: (1) statewide tax solutions, (2) local tax solutions (to cover the cost of projects or road networks in specific areas), and (3) other finance alternatives that involve either cash management or alternative means of project delivery. Exhibit 5-5 presents the range of options considered.

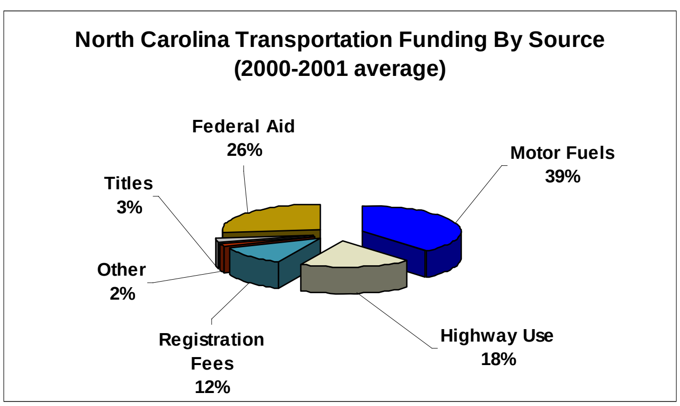
Exhibit 5-5: Potential revenue alternatives to help fund MDOT's budget gap

Statewide Sources	Local Sources	Cash Management and Project Delivery Alternatives
• Tolls (applied to all lanes or only to express or truck lanes) • Cordon tolls in high-traffic areas • Sales and use taxes, income taxes, or other general-fund revenue • Corporate and utility taxes • Airport parking taxes • Casino and gambling taxes • Rental-car, hotel, convention, and other visitor taxes • Real-estate or personal property taxes • Leasing and concessions on right-of-way	• Property taxes • Regional sales taxes • Special assessments • Tax-increment financing • Expansion of the State Infrastructure Bank • Local-option user fees (fuel or vehicle taxes) • City income taxes • Impact fees • Developer contributions	• Road construction by private investors • Private nonprofit corporations (63-20 corporations) • Shadow tolls, privatization, and service contracts • Federal credit assistance • Management of federal aid (advance construction, tapering, and phasing)

5.5.5 North Carolina



NCDOT's recommended investment scenario for its most recent SLRP is fiscally constrained. In preparing the analysis for this constrained scenario, NCDOT applied a budgeting process that was fairly rudimentary but effective for the purposes of the plan. Specifically, NCDOT first identified a set of conservative assumptions regarding the rates of increase in tax revenues and discretionary funds from state and federal sources. These assumptions were then used to generate forecasts of expected annual available funding for each year covered by the plan (i.e., 2000 through 2025). Next, working with internal and external groups including members of the state's Board of Transportation, an NCDOT planning team then prioritized the $83.7 billion in investments identified within the plan (based on the SLRPs stated goals and objectives) to identify a preferred investment scenario that fit the available funding capacity.



Revenue Assumptions and Funding Gap

In preparing its fiscally constrained plan, NCDOT utilized the following conservative assumptions to guide development of the baseline projection:

- No new revenue sources over the 25-year timeline
- Continued growth of current state user fee "transfers"
- Growth in federal-aid funding at an annual average rate of 1.8 percent
- Annual growth in state user fee revenues based on historical patterns—roughly 3 percent for motor fuels and 4 percent for registration and use tax.

Based on these assumptions, NCDOT estimates that a total of $55.5 billion will be available for transportation investment in North Carolina over the next 25 years. This leaves roughly $28.2 million in identified needs unfunded. The current plan does not identify alternative funding strategies or sources.

5.5.6 Utah

Transportation 2030 forecasts available revenue at more than $3.6 billion to put toward major reconstruction and rehabilitation projects, safety improvements, and capacity enhancements for the next 30 years. In contrast, total transportation needs are estimated at more than $13 billion. To address this issue, the current SLRP is financially constrained by year and is intended to provide sufficient financial information and projected revenues to determine which projects and strategies can be implemented over the plan's 25-year period of analysis. The plan also identifies those projects that are needed but are not scheduled to be constructed at this time due to insufficient funding. Sources and uses of funds in the SLRP are summarized in Exhibit 5-6.

Exhibit 5-6: Sources and uses of funds projected in UDOT's SLRP

Sources of Funds
State fuel taxes, license fees and vehicle registration fees
Federal Programs: Interstate Maintenance, National Highway System, Surface Transportation Program, Bridge Replacement and Rehabilitation, etc.
Centennial Highway Fund
Uses of Funds (Preservation of State System)
Contract Maintenance
Signals, Lighting, Barriers
Bridge preventive Maintenance
Bridge Rehab/Replace
Highway Rehab/Replace
Hazard Elimination, Safety Enhancements
Region / Department Contingencies

The appendix to Utah's SLRP contains a 28-year cash flow analysis for the financially constrained plan including all proposed sources and uses of funds through 2030. Because the plan is constrained and state legislation requires that asset preservation needs be met before UDOT can address any capacity improving investments (see Chapter 4), these constrained financial projections only reflect investments in system preservation (i.e., the analysis projects that there is insufficient funding to meet any needs beyond system preservation).

The SLRP states that the plan's revenue and expenditure projections were developed using historical data, predicted changes, and assumptions that account for inflation. The cash flow documentation supports this statement with descriptions of the assumptions used in the plan's development including the timing and percentage amounts of tax increases, assumed rates of growth in federal funds, and assumed inflation rates of capital investment components. These assumptions generally appear conservative, with the rate of inflation for costs being less than that of revenues. The cash flow analysis also includes a cumulative balance of funds (i.e., revenues are set higher than expenditures). This yields an ongoing contingency fund for project overruns and unexpected needs, and also represents sound and conservative financial planning.

5.5.7 Summary

In summary, the techniques used to construct long-term needs estimates and the related budgets are relatively rudimentary. A key reason for their simplicity is the fact that these products are primarily developed for use in the SLRP but generally lack a long-term audience beyond that document (e.g., based on the interviews conducted for this study, state DOTs are not currently making use of long-term needs estimates or long-range budget information beyond reporting them as part of the SLRP). FHWA and state agency asset management staff may wish to encourage development of more comprehensive and sophisticated long-term budgets and cash-flows as a means of better determining the gap between long-term needs and likely funding capacity.

Long-term capital needs: A specific example here would be the development of analytic tools (similar to HERS-ST) capable of estimating consistent statewide long-term needs for preservation and capacity improvements (i.e., without detailed input from engineering assessments). Such tools could also tie into travel demand forecasts to better evaluate long-term asset deterioration expectations (e.g., driven by VMTs), future capacity deficiencies, and future system performance expectations under alternate funding scenarios.

Revenue estimation: Similarly, none of the states interviewed currently uses long-term travel demand forecasting or related analyses to estimate long-term revenues from fuel taxes, vehicle licensing, or registration fees, each of which is a dedicated revenue source whose base is ultimately driven by the demand for transportation.

Operations and maintenance (O&M) cost models: Finally, none of the states interviewed used O&M cost models to estimate the cost of highway system operations and maintenance requirements. As with other analyses, simple two- and three-variable O&M cost models can provide greatly improved accuracy in long-term budgeting capacity and gap analyses.

5.6 Performance Monitoring

Transportation performance measures consist of a set of objective, measurable criteria used to evaluate the performance and effectiveness of the transportation system, as well as the effectiveness of government policies, plans, and programs. Performance measures are also used to gauge the extent to which each state's long-range transportation vision, goals, and objectives (as described above) are being achieved. Performance measures may include such indicators as changes in travel times, transportation-related injuries and fatalities, air and water quality, number or percent of system users in various modes, fuel usage, and travel quality. While not common to all SLRPs, many state DOTs identify their current long-range plans and describe their intended application as a means of measuring the effectiveness of the long-range plan (as eventually implemented) in addressing the plans' stated goals and objectives.

Among the sample of state DOTs selected for this study, only Caltrans and MDOT included a discussion of specific performance measures they intend to use to evaluate the effectiveness of the long-range plan (once implemented) in meeting the SLRPs' goals and objectives. The following describes those performance measures that relate directly or indirectly to auto and track travel demand for each of these states as identified in their SLRPs. These SLRP performance measures are consistent with the measures used elsewhere within their asset management programs.

5.6.1 California

Caltrans has worked actively with representatives of the state's RPOs and MPOs to identify a set of consistent, multimodal, statewide performance measures. Caltrans and its statewide partners have reached consensus on a core set of performance measures. The SLRP lists the types of measures to be considered. Exhibit 5-7 is a listing of those system performance measure "indicators" that correspond to auto and/or freight travel demand-related goals, objectives, and outcomes (as identified within the SLRP).

Exhibit 5-7: Caltrans performance measures listed by SLRP goal

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

5.6.2 Michigan

MDOT has organized the performance measures into three categories: system condition; accessibility, mobility, and safety; and operational and service performance. These categories and the individual performance measures relate either directly or indirectly to the state long-range plan. MDOT tracks more then 100 performance measures in all. The categories of "accessibility, mobility, and safety" and "operational and service performance" relate most closely to issues of travel demand.

Accessibility, Mobility, and Safety performance refers to monitoring how frequently the transportation service is offered, how efficiently it operates, and how many crashes are taking place. For highways, it answers the question, *how congested is the system?* Accessibility best describes the ability of people or goods to reach destinations, where mobility is the relative ease or difficulty with which the trip is made. Mobility is concerned with travel time, speeds, system usage, and system capacities. The most frequently cited performance measures relating to travel demand include:

- Level of service (A through F)
- Travel delay
- Vehicle miles of travel.

These performance measures relate indirectly to MDOT's SLRP goal of strengthening the state's economy and directly to the goal of basic mobility.

Operational and Service performance relates to how well the transportation system is meeting the needs of the traveling public. Key performance measures tracked by MDOT here include:

- Travel time
- Travel delay
- Congestion
- System utilization
- Facility access.

These performance measures relate directly to the SLRPs goal of transportation services coordination as an indicator of how responsive the service is to customer needs.

Chapter 6. Findings and Recommendations

6.1 Key Findings

State DOTs have made great strides over the past decade in implementing TAM processes for a broad range of investment and strategic management activities. Existing TAM processes required significant investments in data collection and database maintenance, decision-support tool development, business process re-engineering, and human-resource development. However, even with these significant investments, progress in incorporating travel-demand measures into state TAM programs remains in its infancy. The following is a summary of key findings:

- *TAM programs:* Each of the agencies interviewed has in place either elements of or strong foundations for a TAM program. At a minimum, all states utilize both pavement and bridge management systems and data collection processes for maintaining the asset inventories used by management systems. In addition, most states maintain current databases of some other highway assets, including the location and condition (or age) of guard rails, drainage, signage, and a variety of other ancillary assets. Beyond these core programs, most states also maintain one or more decision-support tools designed to assist in selecting among a mix of potential rehabilitation options. For two of the study states, asset management analyses were either reflected in or very closely tied to development of the SLRP. Each state indicated a strong interest in further advancing their asset management program with several agencies actively participating in further development actions.

  The TAM programs for each of the four participant states remain primarily focused on system maintenance and preservation. This focus reflects the history of each program's development (developing from a kernel of pavement and bridge management systems) and the particular investment needs, legislative requirements, and "color of money" limitations within each state. Moreover, most agencies tend to focus on the short- to medium-term investment needs, but place less emphasis on long-term objectives (e.g., mitigating congestion). This emphasis is reflected in their TAM program goals and objectives, which are also primarily focused on maintenance and preservation.

- *Travel demand forecasts and TAM:* Each of the agencies interviewed maintains some level of travel demand forecasting capability. These resources are primarily used to provide technical support to local MPOs and RPOs (in many instances, the state's travel demand modelers develop and operate the travel demand models for the smaller MPOs and RPOs) or to support cost-effectiveness analyses of major investment projects. Only two of the four states interviewed maintained statewide travel demand models of sufficient quality to support development of a long-term, strategic assessment of state-wide capacity requirements or future performance expectations.

- *Measures of current travel demand:* In addition to generating long-term travel demand forecasts, each state also actively maintains databases of current travel demand (e.g., traffic counts, VMTs, truck counts) for all state-maintained facilities. Measures of current travel demand are generally available to all interested DOT staff, but are most often used by: (1)

travel demand modelers as raw model input data, (2) managers with responsibilities for the preservation of bridges, pavement, and highway asset types, and (3) external users including MPOs, RPOs, municipalities, researchers, and even state residents.

Current and projected travel demand measures as inputs to the TAM process

- *Infrastructure deterioration (e.g., roadway wear):* Increasing traffic volumes and vehicle weights should result in increasing rates of roadway deterioration.

  While current travel demand volumes are frequently considered *implicitly* by agency management systems (e.g., through annual segment-by-segment roadway condition evaluations), these measures are rarely incorporated *explicitly* into assessments of asset deterioration rates or the subsequent maintenance and rehabilitation requirements. Similarly, projected future travel demand has not been used to model long-term maintenance and preservation needs.

- *Investment prioritization:* **The benefits of reinvesting in existing infrastructure tend to be highest for segments with the highest travel demand (i.e., as there are more users to benefit from the improvements).**

  Only one of the four study states (Utah) has developed a decision support tool that uses travel demand-driven investment benefits to help prioritize short-term preservation investments between locations or regions (i.e., where preservation activities in high utilization links can be prioritized over low demand links for a similar deficiency based on the higher benefits associated with higher volume traffic). While the other states do not *explicitly* include travel demand measures in their statewide investment prioritization, travel demand considerations are *implicitly* reflected through their traditional project review processes.

- *Project benefit-cost and alternatives analysis:* **The cost-effectiveness (or return on investment) of major new investments and the relative benefits of project alternatives are heavily influenced by aggregate travel-time savings.**

  Virtually all of the participant states regularly conduct benefit-cost analyses (or other cost-effectiveness assessments) of proposed major investment projects as well as their investment alternatives. A primary source of investment benefits for these projects is the estimates of aggregate travel-time savings for all travelers projected to use the proposed investment.

Using the TAM process to address issues related to travel demand

- *Capacity improvements:* **As noted above, the rate of growth in travel demand remains well above the rate of growth in roadway capacity, leading to increasing congestion and travel times. Have state DOTs adopted TAM-related practices to help identify capacity improvement strategies or for prioritizing potential expansion investments?**

  As noted above, two of the four participant states (Michigan and California) maintain statewide travel demand models and one (Michigan) maintains a truck model. Development of these tools is critical to the objective and consistent identification and assessment of those travel corridors (both current and future) expected to suffer most from travel demand growth and, hence, having the highest priority investment needs. Combining the data from these forecasting tools with other travel-related metrics, Michigan has identified and prioritized capacity investment needs for several "corridors of highest significance."

- *Trade-offs between preservation and capacity needs:* **All state DOTs face the problem of balancing investment in existing roadway capacity with the need for additional capacity to address growing demand, all within limited financial resources. How have TAM and related processes been used to allocate funds between these and other competing needs, and how do travel demand measures inform this allocation**?

  None of the four states interviewed has yet succeeded in developing an objective process or a decision support tool to optimize the allocation of funds across multiple investment uses (e.g., preservation, capacity improvements, safety, and beatification). To a certain extent, these states have not addressed this possibility due to the existence of state legislation requiring the prioritization of preservation activities over capacity improvements (or the reverse) or due to color of money constraints at both the state and federal levels. A key exception here is Utah, which is working through the problem of establishing a robust benefit-cost process capable of making "apples-to-apples" comparisons between preservation and capacity improvement activities (despite the state legislative requirement that preservation needs be addressed first).

- *Objectives and performance measures:* **TAM emphasizes the need to establish long-term system objectives and to develop processes and measures to evaluate success in attaining those objectives.**

  The current goals and objectives of the participant states' TAM programs reflect the current focus of these programs (i.e., maintenance and preservation), and hence, place little emphasis on travel demand-related concerns (e.g., congestion). In contrast, each DOT's agency-wide goals and objectives, as expressed in strategic documents such as their SLRPs tend to be broader in scope and typically include the maintenance and improvement of mobility as a key goal.

- *Long-term planning for growth in travel demand:* **What are state DOTs doing to plan for long-term travel demand growth?**

  Each of the state DOTs interviewed has identified long-term strategies to address the issue of ongoing, long-term growth in travel demand. These strategies are most clearly expressed in each DOT's SLRP. While the mix of strategies to address travel demand issues varied by state, these strategies generally included the following measures:
  - Increased capacity (e.g., lane and bridge widening)
  - TDM strategies (e.g., telecommuting, real-time information, ridesharing)
  - Operational improvements (e.g., ITS, improved incident management)

- *Long-term budgeting:* **TAM emphasizes the need to take a long-term, strategic view in establishing attainable organizational objectives within realistic resource constraints.**

  The long-range budgeting processes utilized by state DOTs are somewhat rudimentary and have the primary objective of supporting preparation of the SLRP. According to state DOT staff interviewed for this study, long-range budget analyses have no regular "audience" beyond production of the SLRP (i.e., this information is not included in regular reports to upper management). Moreover, unlike MPO long-range plans, SLRPs are not required to be financially constrained (that is, demonstrate the likelihood that funds will be available to cover all proposed projects). Hence, the existing budget analysis within each of the study state's SLRPs represents their own efforts to generate a more comprehensive analysis and more informative document (but not necessarily to prepare a comprehensive long-term budget). The SLRPs for each of the four study states provides an analysis of their current revenue situation, while three of the four plans provide an analysis of the projected gap between long-term needs and anticipated future funding. Only one of the four states interviewed (Utah) prepared a long-term budget cash-flow projection showing the sources and uses of DOT capital and operating funds over the time horizon covered by the state's SLRP.

6.2 Recommendations

As a result of this study, the following are specific recommendations for state DOTs to enhance their existing transportation asset management programs. Also, based on comments received from state DOT staff participating in this study, a second subsection identifies ways in which FHWA may also help state DOTs to improve their existing TAM programs.

6.2.1 Suggestions for State DOTs

- *Refine asset deterioration models (short- and long-term):* While some participant states (most notably Utah and Michigan) have worked hard to develop good preservation investment tradeoff tools (focused on short-term preservation needs and strategies for a specific asset type such as pavement), none of the four states has developed a comprehensive long-term (i.e., 20-year) asset deterioration model that estimates capital reinvestment needs across *all* asset types and *all* regions (i.e., similar to HERS-ST). On the broader asset management front, such tools are critical in evaluating long-term funding requirements for asset preservation. Such models can also be used to evaluate the impact of changes in travel demand volumes (e.g., current and projected auto and truck VMTs) on asset deterioration rates and reinvestment needs. This analysis can help pinpoint which network assets are likely to most require future preservation investments.

- *Develop statewide auto and truck travel demand models:* A clear strength of Michigan's assessment of current conditions and future needs is the ability of the state's travel demand and truck models to evaluate future conditions within specific travel corridors. Statewide travel demand and truck forecasts provide the data required to think strategically about where to focus long-term preservation and capacity investment funds. The construction of such models is key to ensuring an understanding of current and future system performance (volumes, congestion, and trade flows) across their highway network. In support of this objective, FHWA may wish to help foster informational exchanges in the design and maintenance of statewide auto and truck travel demand models.

- *Ensure consistency in project prioritization across regions and districts:* For many state DOTs, the process of project prioritization takes place primarily within the DOT's district or regional offices (typically followed by some limited reprioritization between regions by headquarters staff). Moreover, it is not uncommon for this project prioritization process to vary appreciably from one state DOT district to the next. Such processes lack interregional consistency and, hence, may yield sub-optimal allocations of scarce investment funds. If they are not already doing so, state DOTs need to develop objective and consistent processes and tools to help prioritize investments by region. Such processes should recognize that investment benefits are generally higher on those segments with high travel demand.

- *Ensure consistency between TAM program and SLRP:* State DOTs should view their SLRP as a key component of their asset management program. At a minimum, the goals, objectives, and strategies of the SLRPs should be highly consistent and/or complementary with that of the asset management program and developed in coordination with asset management staff. Optimally, the SLRP should be recognized as a key component of the asset management program (providing a strategic roadmap for the future), with joint production responsibilities across planning, asset management, budget, upper management, and other key agency staff.

- *Long-term budgeting:* As noted above, while each state produces long-range plans in accordance with federal requirements, states do not always prepare an accompanying budget (in part, because these documents are not called for by existing management processes—hence, there is no immediate audience for these assessments, and in part because SLRPs are not required to be financially constrained). State DOTs should consider adopting the practice of preparing and maintaining a comprehensive long-range (i.e., 2-year) budget as a means of more effectively identifying and prioritizing financially attainable long-term investment solutions and performance objectives. A comprehensive long-term budget should include a detailed cash-flow analysis showing the anticipated sources and uses of all capital and operating funds over a long-term forecast horizon. Plans should also be founded on realistic and conservative assumptions regarding rates of inflation and the future funding capacity of state and federal funding sources.

- *Improved coordination with county and local governments:* With the exception of NCDOT (which holds responsibility for more than 80 percent of all roadway miles statewide), the state DOTs interviewed for this study are responsible for, at most, 15 percent of total roadway miles within each state. Hence, most roadway investment and maintenance activities within each state are managed independently by numerous county and local governments. Therefore, the effective development and deployment of a truly *statewide* strategic TAM program requires both: (1) the existence of TAM programs at the local and regional level, and (2) coordination of program metrics, objectives, and execution across all levels of government including state, regional, county, and local. Note that Michigan and Utah both have local and regional TAM programs that coordinate with and frequently obtain technical support from their state's DOT. State DOTs should work to promote TAM practices within the state at the county and local level and work with the state's regional, county and municipal governments to jointly identify, define, and pursue consistent, statewide TAM practices and objectives.

6.2.2 Suggestions for FHWA

- *Technical guidance:* Each of the state DOTs participating in this study indicated a strong interest both in advancing their own asset management program and in learning more about how other states (or other organizations with large asset bases) were addressing similar TAM-related issues. At the same time, these states are striving to derive operational solutions to technical issues associated with the implementation of asset management processes, in many cases working in isolation from each other in solving the same, fundamental technical problems. Examples include the development of comprehensive capital asset databases, robust decision support tools, and meaningful performance measures.

- Based on these and related observations, it is clear that the states would both benefit from and appreciate technical assistance in solving the technical issues associated with making asset management concepts operational. In this regard, many agencies interviewed were well aware of the problems they wanted to solve (e.g., develop metrics capable of effectively assessing investment tradeoffs between rehabilitation and capacity improvements), but frequently lacked the specific technical methods required to develop the associated support tools. Several respondents also suggested that the current asset management literature has proven highly useful in helping to identify the high-level structure, goals, and objectives of a successful TAM program, but offers less in terms of specific solutions to technical issues. The recommendation here is not to provide a single set of solutions that all agencies are expected to follow, but rather a set of suggested approaches to key technical issues (from which agencies can build their own solutions). Specific technical issues to address include:
  - *Prioritization and tradeoff analysis:* Many agencies lack analytic methods or capabilities to assess investment tradeoffs between highway asset types (including pavement, bridges, signage, landscaping, etc.), regions, and operations, preservation, and expansion.
  - *Performance measures:* Each of the four states interviewed has adopted or is in the process of adopting statewide transportation performance measures. The types of measures in use or being considered vary widely from state to state. To some extent, this variation reflects variations in the primary focus of each state's asset management program as well as differences in each state's long-term goals and objectives. However, these differences also reflect varying levels of experience in the development and maintenance of performance measurement systems such that one state suggested it would be beneficial to have further technical support from FHWA in this area (e.g., best practices, information exchange sessions).
  - *Comprehensive asset inventory development:* While most agencies have quality inventories of pavement and bridges, most agencies do not have a single comprehensive inventory of all highway infrastructure assets (e.g., drainage systems or rest area assets). A comprehensive database is valuable in conducting tradeoff analyses of reinvestment between multiple asset types.

- *Legislative constraints:* Existing legislation within each of the sample states as well as program requirements for several federal sources (e.g., federal aid funds) can severely restrict a state DOT's ability to use asset management techniques to optimize the allocation of funds. For example, North Carolina has a legislative requirement to complete build-out of the state's intrastate highway system, a mandate that is counter to the state's increasing need for preservation expenditures. Similarly, federal-aid funds such as the Highway Bridge Replacement and Rehabilitation Program limit the application of funding capacity to a specific purpose, which may not reflect prioritized investment needs. FHWA may wish to consider options by which funds with specific uses may be diverted to alternate uses if justified by supportable analyses. Similarly, state DOT representatives may wish to work directly with state regulators to loosen the fixed funding priorities embedded within existing state transportation legislation (if they conflict with the findings of their asset management programs).

Appendix A

Performance Measures

North Carolina

Bridges

Asset	Performance Measure
Deficient Bridges	% of bridges exceed the national average
Bridge Decks	% of decks rating <6
Superstructure	% of superstructure rating <6
Substructure	% of substructure rating <6
NBIS Culverts	% of culverts rating <6
Non-NBIS Culverts	% of culverts rated “good”
Overhead Signs Structures	% of culverts sign structures rated "good""
Drawbridge Machinery	% of moveable spans with rating <7
Tunnels	Condition rating

Maintenance

Asset	Performance Measure
Low Shoulder	LF that’s => 2 inches
High Shoulder	LF that’s => 1 inch
Lateral Ditches	LF that’s blocked, eroded, etc.
Crossline Pipes (Blocked)	Number of pipes blocked
Crossline Pipes (Damaged)	Number of pipes damaged
Curb & Gutter (Blocked)	LF that’s blocked
Curb & Gutter (Damaged)	LF that’s damaged
Drop Inlets, CB’s etc (Blocked)	Number of inlets blocked
Drop Inlets, CBs, etc. (Damaged)	Number of inlets damaged
Guardrail/Cable Rail/Concrete Median Rail	LF that’s damaged
Attenuators	Number of not functioning properly
Snow and Ice	Time to bare pavement

Roadside

Asset	Performance Measure
Mowing	Average grass height
Brush & Tree Control	% encroaching on clearance zone
Turf condition	% of area with poor turf
Misc. Vegetation Management.	% of area with uncontrolled growth
Litter & Debris	Number of pieces of litter or debris
Storm Water Devices	% of devices not functioning
Landscape Bed Maintenance	% of area needing maintenance
ROW Fence	% of fence needing maintenance
Rest Area & Welcome Centers	Condition rating

Pavements

Asset	Performance Measure

Asset	Performance Measure
IRI	% of LM that's > 145 or PCS severe
Pavement Condition Rating	% of RM < 80
Lane Width	% of lane width < AASHTO standards
Pavement Should Condition	% of shoulder miles in poor condition
Rigid CRC Pavement	% of road miles < good
Paved Should Width	% of paved shoulder < paved shoulder policy

Traffic and ITS

Asset	Performance Measure
Long Line Pavement Markings	LF visible at night
Pavement Markers	% present and reflective
Signs (including lights)	% visible and legible
Roadway lighting	% operational
Traffic Signals	Composite score (operations)
Traffic Signals	Composite score (routine maintenance)
Traffic Signals	Composite score (emergency response)
Highway Free flow	Incident clearance time
Dynamic Message Sign	% incident advised with time frame

Michigan

Asset	Performance Measure
Roadway	• Ride quality – smoothness for motorist • Crack severity – structural deterioration • Wheel rut paths – depressions in pavement • % of roads that are not built to all-weather standards
Runways	• PCI measures of defects – range from 0-100 • Classifications of "good" and "poor" • % "having" or "not having" complete system including: runway length, width, surface types, lighting system, taxi system, safety areas, and visual approach aides
Bridges	• Identify as "good" or "poor"
Buses	• Vehicle mileage and age • Number of buses eligible for replacement compared to % not being replaced • Based on age, the number of buses eligible for replacement • % underfunded
Safety	• Number of accidents per 100 million vehicle miles traveled • Number of accidents per year • Rail grade crossing property damage • Facility crashes
Level of Service	• Average trip speed; total travel time; passenger, vehicle, or freight delay; vehicle miles of travel; person miles traveled; average daily traffic capacity • Measurement of transit use on a per capita basis • Number of passenger terminals served by 2+ modes
Intermodal Facilities	• Number of facilities with direct connections to NHS
ITS	• Usage - calls, website hits • Service Times

California

Asset	Performance Measure
Detection Systems	• Reliability % by detection station, facility, and region • % of urban freeway system covered by detection system
Traffic Control Systems	• Vehicles per hour per lane • Hours of delay experienced • Number of accidents in urban areas
Traveler Information Systems	• Survey of ease of access to detection data • % of system covered • Number of internet site hits • Number of non incident-related messages displayed in the field
Incident Management Systems	• Hours of delay experienced • Number of accidents • Percent variation of travel time for major destination pairs • % of urban freeway covered by CCTV • Identify locations with highest amount of accidents involving pedestrians/bikers
Level of Service	• Amount of motorist delay • Less than 5% of vehicles running at maximum capacity • 85% of public transportation running on time • Reduce complaints by 5% each year
Construction	• % of projects completed on-time and within budget
Safety	• Reduce number of accidents by 5% each year • 50% of employee attend at least one security awareness/disaster preparedness meeting • Transit vehicles per hour

Utah

Asset	Performance Measure
Pavements	• % of roads in "good" or "fair" condition - 90% interstate, 70% arterial, 50% collector
Bridges	• 65% of bridges in "very good" condition, 25% in "good," and 10% in "fair"
Snow and Ice Removal	• Letter grade to snow removal efforts
Signing and Striping	• Letter grade for visibility rating
Traveler Information Systems	• Increases usage of 511 and CommuterLink by 10%/year
Incident Management Systems	• Speed accidents are cleared
Safety	• Reduce fatalities by 2%/year • Reduce pedestrian fatalities by 2%/year • Number of accidents • Severity of accidents
Level of Service	• Motorist travel times

Appendix B

Participating State DOT Staff

The following staff participated in the interviews for this study.

Michigan (March 21-22, 2006):

- Administrator, Asset Management Division
- Transportation Asset Management Coordinator, Asset Management Division
- Manager, Asset Management Section
- Manager, Data Collection Section
- Manager, Project Planning Section
- Manager, Statewide & Urban Travel Analysis Section
- Planner, Statewide & Urban Travel Analysis Section
- Planner, Statewide & Urban Travel Analysis Section
- Administrator, Bureau of Transportation Planning
- Manager, Statewide Systems Management Section
- Director, Bureau of Highway Delivery
- Traffic Operations Engineer, Traffic Operations Section
- MPO Liaison, Bureau of Transportation Planning
- Associate Region Engineer, Development
- Engineer of Maintenance
- Special Projects Coordinator, Project Planning Division
- Administrator, Bureau of Transportation Planning

Utah (March 29-30, 2006)

- Asset Management Director
- Consultant, Deighton Associates Limited Asset Management Implementation Specialist
- Engineer for Planning, Statistics
- Asset Management Engineer
- Engineer for Transportation Planning
- Program Finance Director
- Planning Manager, Modeling
- Director, Utah Technology Transfer Center (LTAP)
- Transportation Planner (Freight)

California (May 17-19, 2006)

- Senior Transportation Planner, Transportation Systems Information
- Office Chief, Transportation Systems Information

- Chief, Office of SHOPP Management
- Senior Bridge Engineer, Office of Specialty Investigations
- Supervising Transportation Engineer (Pavement Management)
- Chief, Office of Strategic Planning/Performance Measurement
- Transportation Planner
- Senior Economist, Division of Transportation Planning
- Research Manager, Transportation Planning
- Chief, Office of Travel Forecasting and Analysis
- Office Chief, Microsimulation Branch of Transportation Systems Information
- Assistant Division Chief, Traffic Operations
- Accountant
- FHWA, California Division, Chief Operations Officer
- FHWA, California Division, Construction & Materials Engineer

North Carolina (June 15-16, 2006)

- Director of Asset Management
- State Roadway Management Engineer
- Secondary Roads Program Manager
- State Pavement Management Engineer
- State Bridge Maintenance Engineer
- State ITS Operations Engineer
- Accountant
- Transportation Engineer, Planning Branch
- Manager, Transportation Planning Branch
- Group Manager, Statewide Planning Branch
- Manager, State Program Development Branch
- Assistant Branch Manager, Program Development
- FHWA, North Carolina Division Planning & Program Development Manager
- FHWA, North Carolina Division, Asset Management Program Manager

Appendix C

State DOT Interview Guide

INTERVIEW GUIDE

Preliminary Schedule

DAY ONE

SESSION 1: Meet individually with asset management **Primary Contact**.

Obtain Overall Understanding of Asset Management Program

- Structure and role within broader DOT organization
- Goals and objectives
- History / development
- Capabilities
- Future plans
- Resources

Obtain Understanding of How Asset Management is Used To Address Travel Demand Issues

- Collection of current and projected future travel demand measures
- Uses of travel demand measures in support of asset management
  - Current operations and maintenance
  - Programming
  - Long-term financial planning
  - Strategic transportation planning
  - Inter-modal, interstate, and international traffic flow considerations
- Conversely, how does asset management process inform infrastructure and financial plans?

SESSIONS 2+: Meet individually with **Secondary Contacts** in other functional DOT teams with asset management and/or travel demand measurement and forecasting responsibilities (e.g., data collection, travel modeling, strategic planning, short- and long-range programming/budgeting, maintenance, and operations). Discuss each division's asset management roles individually:

- Asset management roles and responsibilities
- Interactions with asset management program
- Collection and/or uses of travel demand data
- Successes and opportunities for improvement

DAY TWO

Complete agency staff interviews and any supplementary data collection

- Meet with **Secondary Contacts** not covered on day one
- Follow-up meetings and data collection as required
- Wrap-up meeting with **Primary Contact** (or group of TAM staff) to confirm understanding of DOT TAM program and relation to travel demand

General Module

This section is intended to provide a general understanding of each person/group interviewed and their specific roles and responsibilities with respect to TAM and travel demand measurement and analysis.

1. State:

2. DOT Name:

3. DOT Division:

4. Division Contact(s) Interviewed (name, position, contact information):

5. Division Function and Staff Count:

6. Transportation Asset Management (TAM) Roles and Responsibilities:

7. Number of Division Staff Dedicated to TAM activities (FTEs):

8. From what other divisions do you obtain asset management-related information?

9. To what other divisions do you provide asset management-related information?

10. Does your division collect, report, forecast or utilize asset management data?

11. Do you use or produce travel demand related data in support of your asset management roles and responsibilities?

12. Do you use or produce any other system data such as current or forecast assets, usage, and performance in support of your asset management roles and responsibilities?

13. How is your agency addressing the issue of projected growth in travel demand?

    a. Additional lane miles?

    b. New capacity?

    c. Technology / ITS?

    d. Regulatory?

14. Lessons Learned: What changes would you make to your current TAM practices to better improve program coordination and program success?

15. Lessons Learned: Are there ways your agency could be making better use of travel demand data (either current or forecast) to better manage your assets (i.e., maintenance, operation, re-investment, network capacity improvements)?

<u>Transportation Asset Management (TAM) Primary Contact Module</u>

This section is intended to provide a basic understanding of your state's current transportation asset management (TAM) program. ***This section will only be completed by/with the Primary Contact.***

<u>Organization, Personnel, and Resources</u>

1. Contact information for your division, other related divisions, and key people involved in TAM and/or travel demand measurement & forecasting across the DOT:

2. Is there a single person (or group) that holds primary responsibility for the day-to-day management and coordination of your asset management functions? If so, please identify the person, their title and group/division.

3. Does your asset management program have dedicated resources (e.g., staff and budget)?

4. Do you have examples of reports/materials/analyses produced by or for your asset management function (including any documentation on your asset management program)?

<u>Asset Management Program History</u>

5. Please provide a brief outline of the development history of your TAM program:

    a. When was the program first implemented?

    b. Please provide rough implementation dates for major program components

    c. Please identify any future proposed development initiative for your TAM program.

<u>Coverage & Treatment</u>

6. What facilities / assets are covered by your asset management program/systems (by roadway ownership)?

    a. State highway agency-owned miles

    b. County/town/township/municipal-owned miles

    c. Other jurisdiction-owned miles (non-federal)

    d. Federal agency-owned miles

    e. Bridges and tunnels

    f. Other transportation facilities (e.g., operations centers, VMS, and traffic signals)

    g. Other transportation-related facilities (e.g., travel centers, rest stops, drainage, and parks)

    h. Facilities serving non-highway travel modes (rail, ports, air, transit)

7. Alternatively, are the facilities that are included in the asset management program treated differently based on their ownership?

    a. State highway agency-owned miles

    b. County/town/township/municipal-owned miles

    c. Other jurisdiction-owned miles (non-federal)

    d. Federal agency-owned miles

    e. Bridges and tunnels

    f. Other transportation facilities (e.g., operations centers, VMS, and traffic signals)

    g. Other transportation-related facilities (e.g., travel centers, rest stops, drainage, and parks)

    h. Facilities serving non-highway travel modes (rail, ports, air, and transit)

<u>Relation to Other Programs/Divisions</u>

8. Does your DOT's TAM program have linkages with other DOT divisions or groups (e.g., planning, programming, and maintenance)? If so, please characterize these linkages.

    a. What type of data, information, materials, resources, guidance, or other items are shared between your TAM program and these other divisions?

    b. Is the linkage and sharing of information explicit or implicit (e.g., formalized)?

9. Does your DOT's TAM program have:

    a. An organization-wide asset management strategy?

    b. An integrated mission across divisions / functions?

10. Does your DOT's TAM program have:

    a. Specific policy guidance or objectives relating to current or projected future travel demand (e.g., relating to acceptable levels of congestion, roadway wear or truck sizes/configurations)?

    b. Do you have specific performance standards or targets that incorporate highway demand measures or impacts (e.g., max VMT per lane mile)?

    c. Other guidance or overall program objectives or policies relating to travel demand (e.g., fuel tax revenues).

Communications

11. How are asset management activities coordinated across multiple divisions / groups? Periodic meetings, e-mail distribution lists, intranet site, periodic reports?

12. How is asset management information disseminated to DOT management (executives, division heads, section and modal heads)? Periodic reports, news letters, intranet, e-mail? Is there are a formalized process for reporting this information to management?

13. How is TAM information disseminated to legislators? Is it incorporated into reports intended for the state legislature?

Information Technology and Data Collection

14. Please identify which of the following information technology systems are used to support your asset management program. For each system please identify the platform/software, its function and the division/group responsible for operating and maintaining the system, and the divisions/groups that utilize the system. ***Finally, please indicate whether the IT system utilizes travel demand data—current or forecast—as an input and, if so, how***.

    a. Maintenance management system (e.g., bridge and pavement)

    b. Performance measurement system

    c. Asset inventory (fixed assets listing… see also question 15)

    d. Budgeting/Financial

    e. Decision Support Tools (capital needs, investment tradeoffs, GIS)

    f. Project cost estimating and tracking

    g. Other(s)

15. Does your state maintain a detailed asset inventory of highway infrastructure (e.g., number of lane miles, bridges, maintenance facilities, and fleet vehicles)? Please describe:

    a. Who is responsible for collecting and maintaining this data?

    b. The types of assets included in the inventory (lane miles, bridges, maintenance facilities, admin facilities, vehicles)

    c. What information does the inventory record (asset type, quantities, age, location, utilization)?

    d. Does your system monitor asset condition (e.g., pavement)? If so, how is condition measured, rated and recorded?

    e. Does the inventory record utilization (travel demand) measures? Alternatively, are the asset inventory records tied in any way (e.g., through analyses or relational databases) to travel demand measures? Is this information used to estimate maintenance needs?

f. How frequently is this asset inventory data updated?

g. What divisions have access to this information? / How is asset inventory data (e.g., condition) disseminated within DOT and to whom?

h. Is the asset inventory data incorporated into the budgeting process and, if so, how?

Miscellaneous

16. Capacity Expansion: How are current and future projections of travel demand used to identify needed investments in capacity improvement (e.g., lane widening, additional lanes, bridge improvements and reinforcement)?

17. Design and Materials: How are current and future projections of travel demand incorporated into the design of new facilities or upgrades to existing facilities (e.g., design capacity and materials)?

<u>Secondary Contact Module: Statewide Travel Demand Modeling</u>

Please describe your state's statewide travel model (e.g., statewide freight flows, forecasts for inter-city travel, and integration of regional models with statewide models) and other measurement and forecasting efforts

<u>Statewide travel model</u>

1. Does your state DOT perform a statewide travel demand model/forecast? If not, does your state DOT have plans to perform statewide travel demand modeling in the future?

   a. How mature is your statewide model (e.g., geographic coverage, availability and quality of data inputs, reliability and utility of outputs)?

   b. What travel demand measures does your model produce? Do you forecast other measures separately and, if so, what are they (e.g., vehicle ownership, VMT, freight ton-miles)?

   c. Who is responsible for producing those models and forecasts?

   d. How (i.e., using what methods?)?

   e. Who makes use of your model and/or forecast data?

2. Does your state DOT utilize regional travel demand forecasts produced by other government entities in your state (e.g., MPO models)? If so, please describe and list your sources of travel demand forecasts. What specific measures do these organizations provide (e.g., VMT, traffic counts, ton-miles, other)?

   a. What travel demand measures do you obtain?

   b. Who is responsible for producing those forecasts?

   c. Who makes use of these forecasts?

3. Are travel demand forecast data incorporated into your state's long-range infrastructure and financial planning processes?

   a. How are they utilized?

   b. Who conducts this analysis?

   c. Which travel demand measures?

4. How else are outputs incorporated into your asset management program?

5. Are travel demand forecasts used to predict future performance levels under different investment scenarios (including no investment)?

   a. How are they utilized?

   b. Who conducts this analysis?

   c. Which travel demand measures?

6. How are your travel demand forecasts segmented (alternatively, what groups are travel demand levels forecasted for)?

   a. By type of vehicle?

   b. By vehicle size/weight?

   c. By roadway category (highway, arterial, etc.)

   d. By commodity type / value?

   e. Do the forecasts include interstate / international origin/destination traffic?

<u>Collection and analysis of other data</u>

1. Does your state maintain/report measures of highway infrastructure utilization and performance? What specific performance measures do you monitor/report (e.g., VMT, VMT per lane mile, traffic counts, ton-miles, pavement condition, congestion delay,)? Which of these measures relate directly or indirectly to travel demand?

2. Are there specific performance standards associated with each measure? If so, what are these standards and how were they selected (and by whom)?

3. Who collects these data?

4. How are travel demand and performance data collected, where (for what facility types) and with what frequency (monthly, annual, biennial, “as-needed”, other)?

5. How is the information reported / disseminated and to whom? How are these data utilized by other groups within DOT? (Please provide copies of related reports).

6. Does your organization have/utilize decision support tools that model / evaluate / rank the performance of highway segments / categories? Do these tools incorporate measures of travel demand and if so, how?

7. If you use performance standards, how do you report performance failures? Who are these failures reported to and what course of action is required to address this failure (if any)?

8. Does your existing asset management program utilize current measures of highway travel demand (e.g., VMT, traffic counts, ton miles, other)? If yes:

   a. What specific measures?

   b. How is this information used and by whom (operations, maintenance)?

9. Do you collect/utilize travel demand data for competing or complementary modes to highway (e.g., transit, freight rail, ports)?

<u>Secondary Contact Module: Statewide Strategic Transportation Planning</u>

Please describe your state's long-range transportation infrastructure planning program and process (e.g., who prepares the plan, how often is it updated, what is the planning horizon, and how are the recommendations of the plan used?).

1. What division holds primary responsibility for identifying long-term investment needs?

2. What additional divisions contribute to the investment needs assessment process and how?

3. How are long-term investments (i.e., for expansion and capacity improvements) identified?

4. How are travel demand forecasts incorporated into long-range planning?

5. How often is the long-term plan updated / revised?

6. What project evaluation processes do you use to select between alternate investment options? Do you have a formal process? If so, what is it?

    a. Benefit-Cost / cost-effectiveness ranking?

    b. Investment priority?

    c. Inter-division discussion?

7. How is the long-range infrastructure plan incorporated into (or driven by) your state's asset management program?

8. Does your state have any non-attainment zones? If so, has your state identified strategies for managing current and projected future travel demand on your most congested roadway segments within these zones (e.g., HOV lanes, tolls, congestion pricing, VMS)?

9. Does your state conduct analyses/projections of the travel time, economic, environmental and/or safety impacts of roadway congestion? Are these analyses used to help identify/evaluate future investment needs?

    a. Travel time?

    b. Economic impact?

    c. Environmental?

    d. Safety (crashes, fatalities)?

Secondary Contact Module: Programming/Budgeting (short-term, e.g. TIPs)

1. What division holds primary responsibility for programming and budgeting (short-term)?

2. What additional divisions contribute to the programming and budgeting process and how?

3. How are current measures of highway travel demand used to allocate budget resources to various uses such as capital expansion, operations, and maintenance/preservation?

4. Are current travel demand or projected future travel growth used to determine staffing or skills requirements within your agency?

5. Is current or projected future travel demand data used to plan the locations or distribution of DOT programs, services, or field locations?

6. How has asset management been used to support the allocated between/among highway uses (i.e., operations, maintenance, construction)?

7. Do travel demand considerations play into the allocation process?

8. Please describe any other ways in which forecasts of future travel demand (at the state and/or regional levels) and your asset management program are incorporated into your financial program (e.g., TIPs). If there is no integration, please describe any needs or efforts your state has identified in this area and your judgment of the benefits such integration could deliver.

Secondary Contact Module: Programming/Budgeting (long-term)

1. What division holds primary responsibility for long-range programming and budgeting?

2. What additional divisions contribute to the long-range programming and budgeting process and how?

3. How are travel demand forecasts incorporated into the long-range program/budget?

4. Are current and future measures of highway travel demand used to predict fuel tax revenues?

5. How often is the long-term program plan updated / revised?

6. How are highway funds allocated between/among highway uses (i.e., operations, maintenance, and construction)?

    a. Who conducts these analyses / participates in this process?

    b. What process is used / what methods are used to allocate funds (historical, projected ranking, ROI)?

    c. How is information presented to decision makers?

7. How does your state's asset management program inform the long-range financial plan (and vice versa)?

Secondary Contact Module: Maintenance

1. What division holds responsibility for roadway maintenance?

2. Please distinguish those activities included in maintenance versus those included in construction (i.e., where does the break between maintenance and construction activities lie? Does maintenance only include some level of resurfacing?).

3. Does this division participate in the asset management program?

4. How are travel demand measures used to determine roadway maintenance needs? If so, what measures are used?

5. Does your agency have a process of estimating unconstrained investment needs for the maintenance, rehab and replacement of existing highway infrastructure?

    a. Engineering assessments?

    b. Targeted condition standards based on facility type / traffic volumes?

    c. Decision support tools?

    d. Other(s)?

6. How does your agency currently budget for the upkeep (maintenance, rehab and replacement) of existing highway infrastructure (roads, bridges, facilities, fleets)?

    a. Budget to allocated funding capacity?

    b. Engineering assessments of immediate / highest priority needs?

    c. Targeted condition standards based on facility type / traffic volumes?

    d. Decision support tools?

    e. Other(s)?

7. Does your agency have/utilize decision support tools to model rehab and replacement needs for your existing highway infrastructure (roads, bridges, facilities, fleets)?

    a. If yes, which division holds responsibility for operating/maintaining this tool?

    b. Was the tool developed “in-house” or was it developed by a contractor(s)

    c. What principles / methodologies do these tools use to estimate capital needs?

    d. Are these tools applied to all asset types?

    e. Do these tools use measures of current travel demand (VMT, traffic counts, ton-miles) as a measure of asset utilization/deterioration?

Secondary Contact Module: Operations

1. Which division is primarily responsible for daily roadway operations?

2. Please identify the primary responsibilities of the operations group

3. Does this division participate in the asset management program?

4. What techniques do you use to manage travel demand in the short-term (e.g., VMS, other ITS)?

5. How are real-time (or near real time) data used to support highway operations?

6. How are longer-term data such as travel demand and freight forecasts used to support highway operations tactics and strategies?

Secondary Contact Module: IT

1. Which division is primarily responsible for IT?

2. Please identify the primary responsibilities of the IT group

3. Does this group participate in the asset management program?

4. What asset management systems/databases is the IT group responsible for? Please describe each system and the sources and uses of data (including who uses these data).

5. Please identify all databases and systems that house or utilize current measures of travel demand (e.g., VMTs, AADT, ton miles, other). Who has access to and who utilizes these data?

Appendix D

Michigan DOT Pre-Interview Survey Response

Contact Information

1. State: **MICHIGAN**

2. Agency Name: **MICHIGAN DEPARTMENT OF TRANSPORTATION (MDOT)**

3. Primary Asset Management Contact Person & Contact Information:

   MR. BILL TANSIL
   ADMINISTRATOR, ASSET MANAGEMENT DIVISION
   tansiw@michigan.gov and bakerj@michigan.gov (Judy Baker)
   (517) 335-6879

4. Please identify contacts within each DOT division / group with *asset management* responsibilities, if relevant, that we can meet with to discuss your asset management program. Alternatively, if all TAM responsibilities are housed within a single, "stand-alone" group, please indicate below. Not all rows need be completed if there are no relevant contacts.

Asset Management Contacts

Division	Contact Name	Position/Title	Phone	Email
Planning – Travel Demand; Modeling; Long Range	Susan Gorski	Manager	517-335-2958	gorskis@michigan.gov
	John Watkin	Supervisor	517-373-9038	watkinj@michigan.gov
	Lyle Witherspoon	Supervisor	517-335-2955	witherspoonl@michigan.gov
Statistics / Performance (gathering information now; monitoring highway conditions)	Ron Vibbert	Manager	517-373-9561	vibbertr@michigan.gov
Operations, Project Delivery/Construction	John Friend Highway Delivery	Bureau Director	517-335-1697	friendj@michigan.gov
Maintenance	Jon Reincke Maintenance	Division Administrator	517-322-3331	reinckej@michigan.gov
Finance / Budgeting / Programming	Denise Jackson	Division Administration Manager	517-335-2962	jacksonde@michigan.gov
	Craig Newell		517-272-9074	newellc@michigan.gov
IT	Ron Vibbert	Manager	517-373-9561	vibbertr@michigan.gov
	Wendi Burton	Planner	517-241-4299	burtonwe@michigan.gov
Design	Jeff Reid	Associate Region Engineer - Development	517-750-0446	reidj@michigan.gov
Region or Division Offices (MPO Relationship)	Marsha Small	Manager	517-373-9193	smallm@michigan.gov
Safety	Mark Bott	Engineer	517-335-2625	bottm@michigan.gov
Other				
Other				

Demographic Information

5. Population (est. 2005): **Census estimate 10,120,860**

6. Population growth (1990-2000 or 2005): **1990-2005 percent change: 8.88%**
1990 = 9,295,297
2005 = 10,120,860

7. Population projected annual growth rate: **2005-2030: 0.05% annually , 12.42% total**
2005 estimate = 10,120,860 (Census)
2030 estimate = 11,377,760 (MDOT)

8. Urban/rural population split: **Census 2000: urban 74.7%; rural 25.3%**

9. # of MPOs as of 2006: **12**

General Transportation Asset Management (TAM) Information

10. Please provide a current organization chart for your state's DOT (URL or hard copy attached to the end of this survey). —Attached.

11. Do you have examples of reports/materials/analyses produced by or for your asset management function (specifically, documentation on your asset management program)? —Attached.

12. Coverage: What facilities / assets are covered by your asset management program/systems?

Facility Type	Yes	No	Comments
State highway agency-owned highways	X		
County, town, township, or municipally-owned highways		X	
Other jurisdiction-owned highways		X	
Federal agency-owned highways		X	
Bridges and tunnels	X		
Other transportation facilities (e.g., operations centers, VMS, traffic signals)	X		
Other transportation-related facilities (e.g., travel centers, rest stops, drainage)	X		
Facilities serving non-highway travel modes (rail, ports, air, transit, space)	X		
Other			
Other			

General Travel Demand Information

13. Please identify those DOT divisions / groups that collect, forecast, analyze, or make other uses of *highway travel demand* measures (including VMT, AADT, ton-miles, or other measures). Not all rows need be completed if there are no relevant contacts.

Highway Travel Demand Contacts

Division	Contact Name	Position/Title	Phone	Email
Planning – Travel Demand; Modeling; Long Range	Susan Gorski	Manager	517-335-2958	gorskis@michigan.gov
	John Watkin	Supervisor	517-373-9038	watkinj@michigan.gov
	Lyle Witherspoon	Supervisor	517-335-2955	witherspoonl@michigan.gov
Statistics / Performance (gathering information now; monitoring highway conditions)	**ALL SAME AS PAGE D-1.**			
Operations, Project Delivery/Construction				
Maintenance				
Finance / Budgeting / Programming				
IT				
Design				
Region or Division Offices (MPO Relationship)				
Safety				
Other				
Other				

14. Travel Demand Measurement: Please identify the primary measures of travel demand (either current or projected) currently gathered by your agency.

Measures of **Current** Travel Demand

Measure	Yes	No	Comments
VMT	X		
AADT	X		
Ton-miles	X		
Vehicle ownership			
Other	X		
Other			
Other			

Measures of **Future Projected** Travel Demand

Measure	Yes	No	Comments

Measure	Yes	No	Comments
VMT	X		
AADT	X		
Ton-miles	X		
Vehicle ownership			
Other	X		
Other			
Other			

15. Travel Demand Measure Usage: Please identify specific ways in which travel demand measures (either current or projected) are currently used in your asset management program or for other purposes such as planning, programming, or maintenance activities.

There are two general types of models: system level models and simulation models. System level models have been developed by the Statewide and Urban Travel Analysis Section (SUTA) within the Bureau of Transportation Planning (BTP) at MDOT for each of the urbanized areas population between 50,000 and 100,000 population. The 5 urban areas over 200,000 population are responsible for the development of their own travel demand models. The SUTA Section has a copy of those models in house for project level analysis. The Statewide Model Unit is responsible for providing travel demand modeling analysis outside of the Federal Aid Urban Areas (urbanized areas with populations exceeding 50,000 population). Simulation models are developed for very small areas such as an intersection or series of intersections. They are typically developed by the BTP Project Planning Section or the Bureau of Highways.

Travel demand forecasts are fundamental in determining estimates of future travel to be served by the existing transportation infrastructure (all modes) and in estimating future highway user tax revenues. The forecasts also provide critical information for: MDOT's Statewide and Region Long Range Transportation Plans (SLRP) and Sub-State Plans, the department's Transportation Management Systems, the State Transportation Improvement Program (STIP), Air Quality Conformity Analysis, alternative transportation improvement justification and analysis and other project applications.

Services and activities provided include existing and forecasted (20 year horizon required for planning and project development); population, employment and household data, effective speeds for calculating performance measures and air quality conformity analysis, travel paths, travel times, trip table matrices, passenger or vehicle flows, commodity flows (truck travel), alternative transportation improvement analysis, vehicle miles of travel and customer identification.

Modeling Products

1. Estimated and Forecasted Demographic and Employment Data

   The Transportation Planning process in Michigan begins with an estimate of existing population, households and employment. This provides the data set required for developing the base year trip table. The Michigan Employment Agency (MESA) employer listing provides the initial base year employment data for both the Statewide and Urban planning. These preliminary estimates are reviewed and revised by the Regional or Urban

Planning agencies, or SUTA staff to more fully reflect all employment in the modeled area. The University of Michigan Institute of Labor and Industrial Relations (ILIR) periodically prepare county level population and employment estimates and forecasts for MDOT and these agencies. These are developed using a regional economic and demographic model; Regional Economic Model$_5$ Inc. (REMI). The model is driven by national employment forecasts and their influence on each county's economy along with a cohort model that responds to births and deaths provided by the State's Demographer Office. The model also accounts for migration either as a result of employment changes or retirees moving to or from a county. These data sets can be obtained either as tables or thematic maps.

2. Auto Traffic Forecasts (five year increments) and Growth Rates

   Auto traffic forecasts are available from the statewide model. The results can be requested either as an annual average growth rate or total volume. The user is cautioned to be sure they understand the difference. Another issue to consider is what projects are included in the network being used.

3. Truck Traffic Forecasts (five year increments), Commodity flow, Freight analysis and Growth Rates

   Truck traffic forecasts are available from the truck statewide model. . The results can be requested either as an annual average growth rate or total volume. Truck forecasts are forecasted separately for the passenger statewide model.

4. Level of Service (five year increments)

   The current and forecasted level of service is available from the models. This is computed by comparing the estimated design hour volume to the planning design hour capacity. The estimates are generalized and cannot be used for design purposes but are a general indicator of current and forecasted conditions. These forecasts are based on an annual average growth rate or trip tables for each year. The results can be requested either as an annual average growth rate or total volume.

5. Performance Measures (five year increments)

   Performance measures (such as vehicle hour of delay) can be calculated using the models. The results can be requested either as an annual average growth rate or total volume. The user is cautioned to be sure they understand what trip tables and what networks are being used.

6. Congestion Analysis (five year increments)

   Frequently plots or tables are requested to show the number of roadway miles where the level of service is greater than E.

7. Prioritized List of Network Deficiencies (Based on various criteria)

   The model data bases or other information might be used or combined to rank a list of deficiencies to aid in priority setting.

8. Detour Evaluation

   Models estimate the impact of road closures or partial road closures on other roadways, aiding in detour development.

9. Alternative Analysis

   Models are used to estimate the travel impacts of changes in the road network either through widening existing roads or adding new links.

10. Modal Trade Off Analysis

    Models are used to estimate the travel impacts of diverting trips to other modes.

11. Select Link Analysis

    Select link analysis is a technical procedure that lets one create and assign a separate trip table for vehicles utilizing either an individual link or a series of links.

12. Shortest Path/Travel Times

    One can plot the shortest path between two or more travel zones and estimate the travel time.

13. Air Quality Runs

    Average travel speeds are extracted from the models to estimate vehicle emissions.

14. Growth Rates

    Growth rates are obtained from the travel demand models and reflect the impact that the forecasted growth in households and employment will have on traffic volumes over a twenty year time period horizon.

15. Environmental Justice Analysis

    Models are used to provide demographic profiles, including identifying the size and location of low-income and minority population groups. This provides an assessment of whether or not transportation system investments disproportionately burden or fail to meet needs of any segment of the population.

16. Project Selection

    Models are used to provide current and forecasted level of service and other performance measures used in the project selection.

17. Special Analysis

    Specialized data sets, proximity analysis and other socio-economic analysis can be derived from the model or its associated databases.

18. Mapping

    Maps depicting current and future: population, employment, and networks with all associated attributes and trends.

Measures of **Current** Travel Demand

Measure	*Usage*
VMT	
AADT	
Ton-miles	
Vehicle ownership	
Other	
Other	

Measures of **Future Projected** Travel Demand

Measure	*Usage*
VMT	
AADT	
Ton-miles	
Vehicle ownership	
Other	
Other	

Self-assessment

16. My state DOT:

	Agree	Neutral/ Don't Know	Disagree	Comments
Performs a statewide travel demand forecast or survey at regular intervals (e.g., annual VMT estimates)	X			
Performs a statewide long-range transportation infrastructure plan	X			
Performs statewide long-range transportation financial planning	X			
Includes long-range infrastructure planning as part of the asset management process	X			
Includes long-range financial planning as part of the asset management process	X			
Includes operations and maintenance as part of the asset management process	X			
Includes travel demand forecasting as part of the asset management process	X			

Appendix E

North Carolina DOT Pre-Interview Survey Response

Contact Information

1. State: **NORTH CAROLINA**

2. Agency Name: **NORTH CAROLINA DEPARTMENT OF TRANSPORTATION (NCDOT)**

3. Primary Asset Management Contact Person & Contact Information:

4. Please identify contacts within each DOT division / group with *asset management* responsibilities, if relevant, that we can meet with to discuss your asset management program. Alternatively, if all TAM responsibilities are housed within a single, "stand-alone" group, please indicate below. Not all rows need be completed if there are no relevant contacts.

Asset Management Contacts

Division	Contact Name	Position/Title	Phone	Email	Estimated Time
DOH Preconstruction – Transportation Planning Branch (TPB)	Mike Bruff	Branch Manager	919.733.4705	mbruff@dot.state.nc.us	1
TPB – Systems Planning	Jamal Alavi	Supervisor	919.715.5482 x393	jalavi@dot.state.nc.us	3
	Alpesh Patel	TE III	919.715.5482 x382	agpatel@dot.state.nc.us	
TPB – Traffic Survey	Kent Taylor	State Traffic Survey Engineer	919.212.4550	kltaylor@dot.state.nc.us	0.5
TPB – SW Model R&D	Rhett Fussell	Supervisor	919.715.5482 x 373	rfussell@dot.state.nc.us	2
TPB – Divisional Units	Alena Cook	W. Unit Head	919.715.5737 x70	arcook@dot.state.nc.us	1
	Travis Marshall	E. Unit Head	919.733.4705 x41	tmarshall@dot.state.nc.us	
DOH Preconstruction – TESSB – Safety Systems Management	Brian Mayhew	Traffic Safety Systems Engineer	919.715.7818	bmayhew@dot.state.nc.us	0.5
DOH Preconstruction – TESSB – Congestion Management	James Dunlop	Congestion Management Engineer	919.250.4151	jdunlop@dot.state.nc.us	1
Planning – Program Development (TIP)	Calvin Leggett	Manager	919.733.2031	cleggett@dot.state.nc.us	2
	A.L. Avant	Assistant Manager, TIP	919.733.2039	aavant@dot.state.nc.us	
DOH Operations – Asset Management	Lacy Love	Director	919.733.2330	llove@dot.state.nc.us	1
Asset Management – Pavement	Judith Corley-Lay	State Pavement Management Engineer	919.250.4094	jlay@dot.state.nc.us	1
Asset Management – State Roads	J.P Brandenburg	State Road Maintenance Engineer	919.733.3725	jbrandenburg@dot.state.nc.us	1
Asset Management – Secondary Roads	Delbert Roddenberry	Secondary Roads Manager	919.733.3250	droddenberry@dot.state.nc.us	1

Demographic Information

5. Population (est. 2005):

8,682,066 — http://demog.state.nc.us/

6. Population growth (1990-2000 or 2005):
http://demog.state.nc.us/

April 2000 = 8,049,313
April 1990 = 6,632,448

Between 1990 and 2000, NC experienced population growth of 1,416,865 people OR percent change increase of 21.40%

7. Population projected **annual** growth rate:

Approximately 1.5% per year to the year 2030. NC population expected to equal 12 million by 2030

"Between April 2000 and April 2030, North Carolina's population is expected to grow by 4.020 million people (50.0 percent), reaching 12.067 million by the end of the thirty year period. Over 61 percent of this growth, 2.479 million people, will be the result of net migration into the state" — http://demog.state.nc.us/

8. Urban/rural population split: http://www.census.org

April 2000 split (latest available according to State Demographer):

Rural Pop = 3,199,831 = 40%
Urban Pop = 4,849,482 = 60%

9. # of MPOs as of 2006: **17**

General Transportation Asset Management (TAM) Information

10. Please provide a current organization chart for your state's DOT (URL or hard copy attached to the end of this survey).

— provide hard copy to BAH via Sandy Nance

11. Do you have examples of reports/materials/analyses produced by or for your asset management function (specifically, documentation on your asset management program)?

— answers to questions 11 and 12 provided by Lacy Love

12. Coverage: What facilities / assets are covered by your asset management program/systems?

Facility Type	Yes	No	Comments
State highway agency-owned highways			
County, town, township, or municipally-owned highways			
Other jurisdiction-owned highways			
Federal agency-owned highways			
Bridges and tunnels			
Other transportation facilities (e.g., operations centers, VMS, traffic signals)			
Other transportation-related facilities (e.g., travel centers, rest stops, drainage)			
Facilities serving non-highway travel modes (rail, ports, air, transit, space)			
Other			
Other			

General Travel Demand Information

13. Please identify those DOT divisions / groups that collect, forecast, analyze, or make other uses of *highway travel demand* measures (including VMT, AADT, ton-miles, or other measures). Not all rows need be completed if there are no relevant contacts.

Highway Travel Demand Contacts

Division	Contact Name	Position/Title	Phone	Email
Planning	Mike Bruff	Manager, Transportation Planning	919.733.4705	Mbruff@dot.state.nc.us
Planning—Traffic Survey Group	Kent Taylor	State Traffic Survey Engineer	(919)212-4550	kltaylor@dot.state.nc.us
Statistics / Performance Measurement	N/a			
Operations	Lacy Love	Director of Asset Management	(919)733-2330	llove@dot.state.nc.us
	Bill Rosser	Director of Field Operations	(919)715-5662	brosser@dot.state.nc.us
Maintenance	Lacy Love	Director of Asset Management	(919)733-2330	llove@dot.state.nc.us
	Jennifer Brandenburg	State Road Maintenance Engineer	(919)733-3725	JBrandenburg@dot.state.nc.us
Finance / Budgeting / Programming	Calvin Leggett	Manager Program Development	919.733.2031	cleggett@dot.state.nc.us
	Missy Dickens	Staff Engineer	919.733.2039	mdickens@dot.state.nc.us
IT	N/a			
Project Delivery / Design / Construction	Steve DeWitt	Director of Construction	(919)715-4458	sdewitt@dot.state.nc.us
Region or Division Offices	Bill Rosser	Director of Field Operations	(919)715-5662	brosser@dot.state.nc.us
Safety	Kevin Lacy	State Traffic Engineer	(919)733-3915	jklacy@dot.state.nc.us
Communications	Ernie Seneca	Director Public Information Office	(919)733-2522	eseneca@dot.state.nc.us
	Lisa Crawley	Public Relations Officer		lcrawley@dot.state.nc.us
Other—GIS Unit	LC Smith	Director of GIS	(919)212-6001	lcsmith@dot.state.nc.us
	Hardee Cox	Data Compilation Manager		hcox@dot.state.nc.us

14. Travel Demand Measurement: Please identify the primary measures of travel demand (either current or projected) currently gathered by your agency.

Measures of **Current** Travel Demand

Measure	Yes	No	Comments

Measure	Yes	No	Comments
VMT	X		Reported annually after HPMS data provided to FHWA. Note: Statewide reporting procedure needs to be updated. GIS unit maintains and reports this information per county and for entire state.
AADT	X		Primary system is collected every year unless entire county falls under an urban area. Urban area counts split between odd and even years. Interstates counted every year. Secondary roads are every 2 years.
Ton-miles		X	NCDOT does not collect. Referenced information found at BTS and FAF websites supported by FHWA
Vehicle ownership	X		DMV maintains vehicle registration records—currently over 7 million registered vehicles in the state
Other			
Other			
Other			

Measures of **Future Projected** Travel Demand

Measure	Yes	No	Comments
VMT	X		Projections to years 2010, 2020, 2030 have been made by GIS unit for each county. Based solely on historical trend.
AADT	X		Traffic forecasts are developed for projects throughout the state to help determine project scope, design/traffic operation decisions, and environmental/social impacts
Ton-miles	X		Currently developing a statewide truck travel demand model to ascertain impacts of truck movement on congestion, level of service. Model output will be input for another study on truck profiles, vehicle class and impacts of overweight trucks to pavement/bridges. Ton-miles, tonnage, commodity by value data expected from FHWA late July/early August
Vehicle ownership		X	No reported predictions are made on vehicle registration
Other			
Other			
Other			

15. Travel Demand Measure Usage: Please identify specific ways in which travel demand measures (either current or projected) are currently used in your asset management program or for other purposes such as planning, programming, or maintenance activities.

Measures of Current Travel Demand

Measure	Usage
VMT	Mostly used in charts/graphs to show increasing level of demand on system vs. slower growth of revenue. Disparity between VMT and revenue has lead to policy discussions with Board of Transportation and outreach to public to seek new ways to fund transportation (October 2005)
AADT	Future projected more important for planning/programming
Ton-miles	Not used in planning
Vehicle ownership	Role in trip generation in travel demand models – trip generating capacity tied to income for housing and commercial vehicle information collected for employment
Other	
Other	

Measures of **Future Projected** Travel Demand

Measure	Usage
VMT	Same issue as current but further disparity in the future between VMT and revenue

Measure	Usage
AADT	Traffic forecasts are developed for projects throughout the state to help determine project scope, design/traffic operation decisions, and environmental/social impacts
Ton-miles	If initiatives mentioned under "comments" section of Q 14 are used and emphasized, ton mile measurement could have impact on improved strategy to address infrastructure maintenance and enforcement of overweight trucks
Vehicle ownership	
Other	
Other	

Self-assessment

16. My state DOT:

	Agree	Neutral/ Don't Know	Disagree	Comments
Performs a statewide travel demand forecast or survey at regular intervals (e.g., annual VMT estimates)	X—not a forecast but an annual VMT calculation based on ADT and historical information.			
Performs a statewide long-range transportation infrastructure plan	X—current Plan was adopted in 2004, Board of Transportation recommends Plan be updated every 2 years			
Performs statewide long-range transportation financial planning	X DOT performs cash forecasting via Financial Management Division. Forecasts are: —1 year —36 month —8 year forecasts			
Includes long-range infrastructure planning as part of the asset management process	Statewide Plan outlines investment goals under three areas of system improvement—Maintenance/Pres., Modernization, Expansion. Transportation Plans for local areas generally focus on capacity, operational and safety improvements not maintenance			
Includes long-range financial planning as part of the asset management process	Recent example of *Moving Ahead* program allowed use of cash balances in trust funds to be applied towards maintenance/traffic operational improvement projects			
Includes operations and maintenance as part of the asset management process	X—just starting new Highway Performance Based Management overseen by Operations			
Includes travel demand forecasting as part of the asset management process	X—will have some role in LOS standards instituted under Highway Performance Based Management			

Appendix F

Utah DOT Pre-Interview Survey Response

Contact Information

1. State: **UTAH**

2. Agency Name: **UTAH DEPARTMENT OF TRANSPORTATION (UDOT)**

3. Primary Asset Management Contact Person & Contact Information:

   MR. KIM SCHVANEVELDT, P.E.
   ENGINEER FOR TRANSPORTATION PLANNING
   kschvaneveldt@utah.gov
   (801) 965-4354

4. Please identify contacts within each DOT division / group with *asset management* responsibilities, if relevant, that we can meet with to discuss your asset management program. Alternatively, if all TAM responsibilities are housed within a single, "stand-alone" group, please indicate below. Not all rows need be completed if there are no relevant contacts.

Asset Management Contacts

Division	Contact Name	Position/Title	Phone	Email
Planning	Kim Schvaneveldt	Engineer for Transportation Planning	801 965-4354	kschvaneveldt@utah.gov
Statistics / Performance Measurement	Bill Lawrence	Engineer for Planning Statistics	801 965-4560	billlawrence@utah.gov
Operations	Tracy Conti	Operations Engineer	801 965-4895	tconti@utah.gov
Maintenance	Rich Clarke	Engineer for Maintenance	801 965-4120	richardclarke@utah.gov
Finance / Budgeting / Programming	Max Ditlevsen	Program Finance Director	801 964-4468	mditlevsen@utah.gov
IT	Michelle Verucchi	IT Analyst	801 965-4490	mverucchi@utah.gov
Project Delivery / Design / Construction	Jim McMinimee	Project Development Director	801 965-4022	jmcminimee@utah.gov
Region or Division Offices	R1 Wayne Felix	Pavement Management Engineer	801 399-0351	wfelix@utah.gov
	R2 Lonnie Marchant		801 975-4928	lmarchant@utah.gov
	R3 Matt Parker		801 830-9563	mparker@utah.gov
	R4 Scott Goodwin		435 896-1361	sgoodwin@utah.gov
Safety	Robert Hull	Engineer for Traffic & Safety	801 965-4273	rhull@utah.gov
Communications				

Demographic Information

5. Population (est. 2005): 2,529,000 (GOPB)

6. Population growth (1990-2000 or 2005): 1990-2000 30+%

7. Population projected annual growth rate: 2000 – 2005 = 10.6%;
   2005 – 2050 = 1.8%

8. Urban/rural population split: 2005 at county level Urban=2,141,293 Rural=387,633

9. # of MPOs as of 2006: 4

General Transportation Asset Management (TAM) Information

10. Please provide a current organization chart for your state's DOT (URL or hard copy attached to the end of this survey).

11. Do you have examples of reports/materials/analyses produced by or for your asset management function (specifically, documentation on your asset management program)?

12. Coverage: What facilities / assets are covered by your asset management program/systems?

Facility Type	Yes	No	Comments
State highway agency-owned highways	X		
County, town, township, or municipally-owned highways		X	
Other jurisdiction-owned highways		X	
Federal agency-owned highways		X	
Bridges and tunnels	X		Bridges only
Other transportation facilities (e.g., operations centers, VMS, traffic signals)		X	Under development
Other transportation-related facilities (e.g., travel centers, rest stops, drainage)		X	Under development
Facilities serving non-highway travel modes (rail, ports, air, transit, space)		X	
Other			
Other			

General Travel Demand Information

13. Please identify those DOT divisions / groups that collect, forecast, analyze, or make other uses of *highway travel demand* measures (including VMT, AADT, ton-miles, or other measures). Not all rows need be completed if there are no relevant contacts.

Highway Travel Demand Contacts

Division	Contact Name	Position/Title	Phone	Email
Planning	Walt Steinvorth	Transportation Planner	801 965-3864	wsteinvorth@utah.gov
Statistics / Performance Measurement	Bill Lawrence	Engineer for Planning Statistics	801 965-4560	billlawrence@utah.gov
Operations				
Maintenance				
Finance / Budgeting / Programming				
IT				
Project Delivery / Design / Construction				
Region or Division Offices				
Safety	Peter Jager		801 965-4264	pjager@utah.gov
Communications				
Other				

14. Travel Demand Measurement: Please identify the primary measures of travel demand (either current or projected) currently gathered by your agency.

Measures of **Current** Travel Demand

Measure	Yes	No	Comments
VMT	X		
AADT	X		
Ton-miles			
Vehicle ownership			
Other			
Other			
Other			

Measures of **Future Projected** Travel Demand

Measure	Yes	No	Comments
VMT	X		
AADT	X		
Ton-miles			
Vehicle ownership			
Other			
Other			

15. Travel Demand Measure Usage: Please identify specific ways in which travel demand measures (either current or projected) are currently used in your asset management program or for other purposes such as planning, programming, or maintenance activities.

Measures of **Current Travel** Demand

Measure	*Usage*
VMT	In pavement management & asset management
AADT	In pavement management & asset management
Ton-miles	
Vehicle ownership	
Other	
Other	

Measures of **Future Projected** Travel Demand

Measure	*Usage*
VMT	In pavement management & asset management
AADT	In pavement management & asset management
Ton-miles	
Vehicle ownership	
Other	
Other	

Self-assessment

16. My state DOT:

	Agree	Neutral/ Don't Know	Disagree	Comments
Performs a statewide travel demand forecast or survey at regular intervals (e.g., annual VMT estimates)	X			Yearly on state system at planning and project level
Performs a statewide long-range transportation infrastructure plan	X			Policy & Project based
Performs statewide long-range transportation financial planning	X			To fiscally constrain plan
Includes long-range infrastructure planning as part of the asset management process	X			Have 10 year Preservation Plan
Includes long-range financial planning as part of the asset management process	X			To fiscally constrain plan
Includes operations and maintenance as part of the asset management process				Under development
Includes travel demand forecasting as part of the asset management process	X			Built into pavement management model