Transportation Asset Management Case Studies

Presented by

U.S. Department of Transportation
Federal Highway Administration

MANAGEMENT SYSTEMS: DRIVING PERFORMANCE

A Glance at Data-Driven Decisionmaking Practices

Note From the Directors

With factors such as an aging national infrastructure, increasing congestion, and limited funds weighing heavily on transportation agencies, State departments of transportation are looking for innovative ways to manage and maintain their transportation assets.

One tool that continues to provide great benefits is transportation asset management (TAM), a strategic approach that strives to provide the best return for each dollar invested. A TAM approach can provide valuable information for planning, programming, and overall management of the transportation network. Information from management systems is essential in transportation decisionmaking to establish realistic agency goals; set investment levels across assets, including transportation system safety, operations, preservation, and maintenance; and select priorities for Statewide Transportation Improvement Program preparation. In general, TAM uses information from management systems to form a performance-based approach for managing the network.

TAM endeavors vary from State to State and include efforts in areas of pavement and bridge management, network preservation, economics in asset management, life-cycle cost analysis, highway safety and operations, among others. The Federal Highway Administration (FHWA) believes that transportation agencies work more efficiently when information about one another's successes is shared. Recognizing that each State's experience is unique, FHWA's Office of Asset Management is continuing its series of TAM case study reports, which began in 2002.

On behalf of FHWA's Office of Asset Management and Office of Planning, we are pleased to present this case study on the application of management systems for planning and programming. Information from management systems with engineering and economic analysis is an important element of planning, programming, and decisionmaking. We believe that this and other case studies will help transportation agencies meet the increasingly complex challenges facing them today.

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Note to the Reader

The Transportation Asset Management Case Study Series is the result of a partnership between State departments of transportation and the Federal Highway Administration (FHWA) Office of Asset Management. FHWA provides the forum from which to share information, and the individual States provide the details of their experiences. For each case study report, FHWA interviewed State transportation staff, and the resulting material was approved by the State. As such, the reports rely on the agencies' own assessment of their experience. Readers should note that the reported results may or may not be reproducible in other organizations.

Executive Summary

In recent years, the transportation community has shifted its emphasis from building and expanding the transportation system to preserving and better managing the transportation system. With an aging infrastructure, increasing congestion, and limited financial resources, sharing, understanding, and adopting innovative best practices are the keys to maximize system performance, improve the customer's experience, and minimize life-cycle costs.

Asset management is an efficient and cost-effective management approach that allows for strategic decisions as to how specific resources should be deployed. Asset management is a true value added to transportation planning and programming, which has become a challenging task due to limited funding. Planners and programmers who face budget constraints are to prioritize and select candidate projects from a pool of needed work throughout their States or local jurisdictions. Information from various management systems, including highway pavements, bridges, safety, traffic congestion, public-transportation facilities, and other assets, are extremely valuable to transportation agencies that are under increasing pressure to balance their budgets while responding to public demands for quality services.

Another important aspect of asset management is that it allows for the implementation of performance-based goals. It is clear that that current public and political sentiment in the United States demands greater accountability from the infrastructure owners and operators. Planning and programming decisions made based on asset management and performance management are key to such accountability. ■

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TRANSPORTATION ASSET MANAGEMENT TO TRANSPORTATION PLANNING

Transportation asset management (TAM) is a strategic and systematic process of allocating resources for the preservation, operation, management, upgrade, and expansion of the Nation's transportation infrastructure. Through the use of management systems and other tools, such as engineering and economic analyses, transportation agencies can strive to ensure the proper use and performance of those assets. TAM provides a holistic framework for agencies to maximize the return on investment, improve system performance, and increase customer satisfaction.

Transportation planning is a decisionmaking process. To make an informed decision, tools are needed to measure, assess, and forecast the impacts of transportation-planning alternatives. As a range of investment options are considered during the planning process, information-management systems that provide timely analyses and information to evaluate the cost and performance of various options and scenarios become quite important.

In this light, TAM is a true value added to transportation planning. TAM provides a link between policies and plan implementation within the decisionmaking framework and ensures that services and performance are aligned to customer's expectations. TAM relies on data and data analysis to optimize the planning, preservation, improvement, and replacement of assets. Instead of simply accounting for existing infrastructure and a series of individual projects, TAM looks at the whole network and makes strategic decisions as to how specific resources—money and staff—should be deployed. TAM serves as a critical link to connect the people who create the systems to those who manage and/or monitor the systems.

Transportation Asset Management relies on data and data analysis to optimize the planning, preservation, improvement, and replacement of assets.

APPLICATION OF MANAGEMENT SYSTEMS FOR VARIOUS ASSETS

In recent years, the transportation community has shifted its emphasis from building the transportation system to managing and enhancing the performance of our transportation system. As the transportation community moves from a program philosophy of being reactive and utilizing the worst-first approach, to that of developing a more strategic approach to asset management, more State transportation agencies are using many of the TAM principles to preserve the system and maximize its performance. A phrase commonly used is "Keep the good road good." Several States even have legislation that requires the implementation of TAM principles linked with funding to their management programs. Legislation can be helpful in setting a clear statewide vision and preserving revenues for important asset preservation.

Information from management systems for highway pavements, bridges, safety, traffic congestion, public-transportation facilities, and other assets are valuable as transportation agencies are under increasing pressure to balance their budgets and at the same time respond to public demands for quality services. The use of management-systems information provides a framework for cost-effective decisionmaking that emphasizes enhanced service at reduced life-cycle costs. The primary outcome of transportation-management systems is improved system performance and safety. There are many different TAM information-management systems, and although the number and types of these systems do vary from State-to-State, benefits can be reaped from understanding the structure of existing information-management systems in a way that improves data analysis, tradeoff analysis, and decisionmaking.

The use of management-systems information provides a framework for cost-effective decision-making that emphasizes enhanced service at reduced life-cycle costs.

COLLABORATION, INTEGRATED PLANNING, AND ASSET MANAGEMENT DECISIONMAKING

Federal planning regulations are codified in 23 CFR 450. According to §450.208(e), each State may apply asset-management principles and techniques in establishing planning goals, defining statewide Transportation Improvement Program (TIP) priorities, and assessing transportation-investment decisions, including transportation-system safety, operations, preservation, and maintenance. Likewise, with the metropolitan transportation-planning process under §450.306(e), metropolitan planning organizations (MPOs), States, and public-transportation operators may apply asset-management principles and techniques in establishing planning goals, defining TIP priorities, and assessing transportation-investment decisions. These include transportation-system safety, operations, preservation, and maintenance, as well as strategies and policies to support homeland security and to safeguard the personal security of all motorized and non-motorized users.

TAM covers a broad range of activities and functions. It touches nearly every aspect of the business functions of a transportation agency, including planning, engineering, finance, programming, construction, maintenance, and information systems.

There are various management approaches used by organizations to manage their assets. Asset management is an efficient and cost-effective approach that strategically targets resources. The concept of asset management covers a broad range of activities and functions. It touches nearly every aspect of the business functions of a transportation agency, including planning, engineering, finance, programming, construction, maintenance, and information systems. Asset management includes investment decisions, prioritization, relationships with different stakeholders and partners, long-range transportation planning, capital-project development, and more.

Many State departments of transportation are beginning to integrate asset management into their business practices. They are moving from a program philosophy of being reactive to developing a more strategic approach. As State transportation agencies continue to deal with limited funding, they are moving toward performance measures for budgeting and capital programming to focus their resources on key strategic business plans or goals and to improve their accountability to the traveling public. Several States even have legislation that requires the implementation of performance-based goals associated with asset management.

When programming and planning transportation, investment opportunities must occur in a coordinated and collaborative manner. The challenge for any organization is to ensure that it has sufficient funding to preserve the road system, while still meeting the infrastructure needs of the region it serves. The selection of different projects to be included in a planning budget is constrained by available funding and usually requires some type of prioritization. By linking strategic performance measures to assets, operations, and maintenance, a connection between the policies and plan implementations can be established. The condition data and future performance data provide feedback and updates to the decisionmaking process and verifies whether the system satisfies transportation and land-use goals or requires major capital improvements.

EXAMPLES OF MANAGEMENT SYSTEMS FOR VARIOUS ASSETS IN TRANSPORTATION PLANNING

Montana Department of Transportation (MDT): Performance Planning Process

Montana is a large, rural, and sparsely populated State. Its extensive highway system plays a central role in connecting its residents and communities to each other and the world. The transportation system is the largest single capital investment in Montana. The challenge for the Montana Department of Transportation (MDT) is to identify the most effective strategies for preserving and maintaining the system.

TranPlan 21, MDT's long-range transportation policy plan, commits to establish a process for setting overall priorities for resource allocation. This process is called the Performance Programming Process (P^3), which is an iterative trade-off analysis that uses management systems to generate a funding level that best meets performance goals. The P^3 process emphasizes equity of conditions per functional class road among each of their five districts. The analysis relies on the best available conditions data and

trade-off scenarios to ensure that dollars are allocated based on the general public's travel priorities. P^3 enables MDT to select those projects that will yield the biggest benefits to the users of the highway system. Montana refines this process by continually modifying P^3's predictive analysis tool to more closely reflect actual results and trends in the field.

P^3 uses the outputs from MDT's pavement-, bridge-, and congestion-management systems to assess alternative investments and strategies that contribute to system-performance goals. P^3 allocates resources to systems, districts, and the different categories of projects to meet or exceed performance goals. Project selection is usually made among projects that belong in the same asset class. Many States are looking to integrate the individual management systems into a statewide management process, but currently most States analyze the management systems separately. In the overall process that transportation agencies go through for setting priorities—funding, performance measures, budgets, and planning—many identify information from their management systems as key inputs to statewide planning and operation.

When TranPlan 21 was completed in 1995, it set a direction for the agency to use output from the management systems in the P^3. It linked project selection with policy and planning goals, with an emphasis on

improving pavement conditions on the State's arterial highways. A dedicated funding source for pavement preservation since 1997, along with guidelines for project selection that emphasize a balanced program, it has provided for a broader array of projects. This includes preservation, minor and major rehabilitation, and reconstruction projects that are implemented in a timely and effective manner. The result is a trend for all State roadway systems to sustain a gradual improvement in their conditions. In 2000, 64 percent of Interstates were classified in good condition; by 2007, 91 percent were classified in good condition. This trend continues across all State roadway systems. MDT's success in meeting its performance goals serves as a model for others. Its pavement-preservation program is a team effort that crosses many departments, including engineering, planning, operations, and maintenance within MDT.

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Vermont Agency of Transportation (VTrans): Planning Initiative

Vermont is a small State with an aging infrastructure that must be preserved. The Vermont Agency of Transportation (VTrans) is one of the few State agencies that have asset management and performance measures written into statute.

In 2005, VTrans developed a quantifiable project prioritization method that assigns a numeric score to projects listed in the annual budget. These scores help explain why one project is chosen over another. Per statute, the scoring system must include "asset-management–based factors, which are objective and quantifiable" including:

- Safety.
- Traffic volume.
- Availability of alternate routes.
- Future maintenance and reconstruction costs.
- Priorities assigned by the regional planning commission or the Chittenden County MPO.

VTrans incorporates local project priorities from their MPO and regional planning commissions into the overall priority for projects listed in the capital program. These quantitative scores drive the transportation-project choices within asset classes. The entire process is transparent, with local and VTrans project scores available for anyone to see.

In addition, VTrans developed strategic performance measures that focus on programs and asset classes. These measures track and analyze investments with a single type of asset, such as pavement, bridges, safety, and maintenance.

Decisions on where to budget money for assets depend on the priority scores and associated performance measures, as well as on the current asset condition and institutional knowledge. This same information assists decisionmakers as they evaluate among different asset classes to determine the relative program size. VTrans continues to enhance the process as they advance its statewide TAM effort.

There are many factors used by VTrans to prioritize projects. In the paving section, information is collected about pavement surface conditions with a specially equipped van, which measures rutting, cracking, pavement roughness, and more. Historical data is factored into the analysis to calculate estimated future pavement conditions at different funding levels. This data is analyzed for the entire State highway network to determine the optimum treatment to maximize the pavement's life expectancy. These factors are combined with regional priorities to develop the VTrans annual paving program. The factors for paving include the pavement condition index (based on 20 points), benefit–cost (60 points), and regional priority (20 points). The results from these analyses are summarized for the three program funding categories: Interstate, State highways, and town highways.

For comparison purposes, VTrans also ran a worst-first scenario to measure the benefit of using an asset-management approach that applies the right treatment at the right time. Figure 1 shows two $55-million scenarios: One scenario uses asset management and the other uses a worst-first scenario.

Asset-management analysis is also used as part of the VTrans preservation-first program, which began in 2006 and is called "The Road to Affordability." This program postpones a number of highway-capacity projects in order to shift the focus to preserving pavements, bridges, and

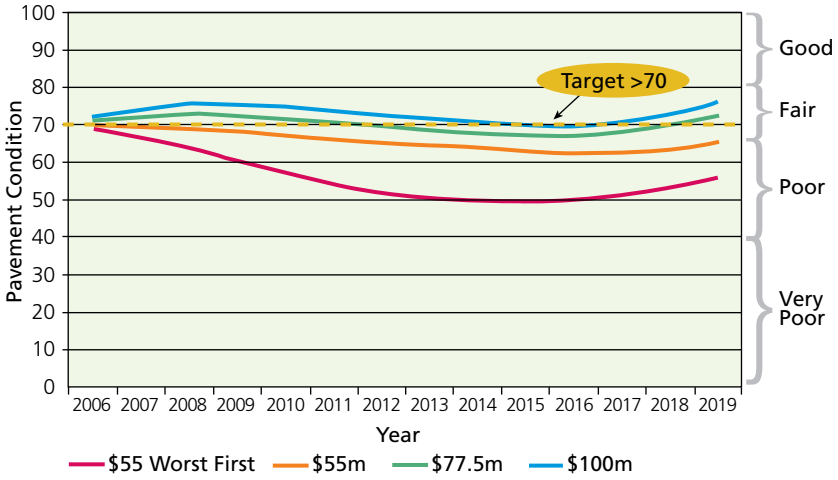


Figure 1. Graph. Future travel weighted pavement conditions at different funding levels.

culverts. To help support this effort, VTrans formed an asset-management unit in the roadway section. At present, their focus is on culverts, signs, and substandard sections of roadway.

VTrans has started a long-term effort to integrate data from the independent asset-management systems into an improved data warehouse. The objective is to improve decisionmaking for transportation-program managers and to help evaluate among asset classes.

State of New Jersey: Statewide Capital Investment Strategy (SCIS)

New Jersey's Statewide Capital Investment Strategy (SCIS) is a decision-making tool used to develop investment options for transportation categories based on goals, objectives, and performance measures. Of note, it includes transportation investments in common categories across agencies rather than in separate strategies for each agency. This integrated approach allows the public to better understand the total State investment needed for roads, bridges, and public transportation. This overview permits and fosters a collaborative approach to make the best use of available transportation funding in order to provide the most efficient and effective use of resources.

The SCIS is an asset-management approach for maintaining, upgrading, and operating physical-asset costs effectively. This effort involved the New Jersey Department of Transportation, New Jersey Transit, the New Jersey Turnpike Authority, and the South Jersey Transportation Authority, as well as the State's three MPOs. The SCIS links broad goals and policies to the specific investment choice by allocating resources into major transportation-asset categories, which are based on various investment options guided by investment targets and clear policy goals.

The SCIS shows the total infrastructure and other investment needs associated with each category and establishes 10-year-target annual investment levels for each category based on predicted revenue levels. It is important to understand that each agency's revenues are independent. Capital work done by each transportation agency is classified into program categories along with associated goals, objectives, and performance measures for each. These categories include bridges, road, mass transit, airports, safety, congestion, multimodal, transportation-support facilities, and local support. Various alternative investment scenarios are evaluated to select investment targets within the constrained budget. The outcome is the desired investment target amount that is connected to a level predetermined to achieve performance objectives. SCIS improves the State's ability to prioritize transportation programs and projects related to system objec-

tives and performance measures. This process is a collaborative approach to making the best use of available transportation funding in an efficient and effective manner.

In New Jersey, the significant funding increased enough to set in motion a comprehensive pavement program that consisted of various treatments for highway problems.

SCIS has the ability to link the selection of projects for capital funding with broad program objectives. On the basis of pavement-preservation goals, a performance analysis is conducted to determine how well various alternative investment scenarios perform over time. This identifies the trade-offs and outcomes that are to be expected from the resulting project mix. In New Jersey, the goal was to eliminate one half of the backlog of deficient pavements over the next 10 years. On the basis of the State's findings, recommendations were made to increase the funding level for highway resurfacing, highway capital maintenance, and highway rehabilitation and reconstruction programs to achieve these objectives. The significant funding increased enough to set in motion a comprehensive pavement program that consisted of various treatments for highway problems in order to prevent the constant downward trend. These treatments include both (a) expensive rehabilitation and reconstruction projects and (b) less-expensive resurfacing projects that extend service life and improve smoothness, with a wide range of lower cost and often innovative, preventative maintenance-repair techniques. With competing transportation needs and limited funding, the SCIS focuses on producing better system-wide pavement quality, as opposed to focusing only on worst-first recommendation projects.

Tucson, AZ: Pima Association of Governments (PAG)

Pima Association of Governments (PAG) is the MPO for the Eastern Pima County and the Tucson, AZ, urbanized area. Planning for PAG's Regional Transportation Plan and TIP includes a focus on cross-jurisdictional planning issues, such as air quality, water quality, transportation, and population growth. Candidate projects are evaluated by using established criteria set by the TIP. The principle criteria consist of the following eight items:

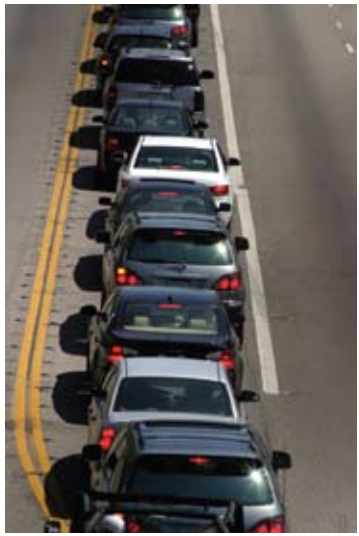
- Safety benefits.
- Congestion benefits.
- Accessibility improvements.
- Volume of use.
- Environmental benefits.
- System preservation.
- Regional significance.
- Improved system continuity.

The goal of the process is to develop a TIP that makes optimum use of available Federal, State, and local funds and resources to serve the region's multimodal transportation needs. Each member agency or jurisdiction can use its own capital improvement projects' process to determine which projects to propose; however, to preserve and enhance the existing transportation system, priority projects also are identified through regional management systems, including pavement-, safety-, congestion-, and bridge-management systems. Although decisions at this level are usually more project-oriented than program-oriented, the actions conducted at the project level do allow for easy feedback into the decisionmaking process, specifically on how performance measures are being met. Strong emphasis is placed on gathering data for these project-level decisions; thus, with a continuous increased knowledge base and asset-management data inventories, PAG continues to enhance its regional transportation-planning process.

A prime example of enhancing the regional transportation-planning process is PAG's Regional Pavement Management Program, which has allowed the region to quickly identify ready-to-go pavement-preservation projects for the Federal American Recovery and Reinvestment Act (ARRA) of 2009. Pavement-preservation projects represented 9 out of the top 10 transportation priorities for the region's ARRA list. Although PAG owns no roadway infrastructure of its own, the agency coordinates the program to ensure that all PAG-member agencies have the capability to understand pavement conditions and rehabilitation needs for their pavement assets.

PAG coordinates regional pavement data collection among its member agencies through the use of a shared-resource, pavement-management van. The van collects consistent and accurate data about particular roadways,

such as pavement condition, the ride quality of the roadway, and the precise location information of specific features on or near the roadway. PAG has taken this program one step further by providing its jurisdictions with the capability to prioritize and forecast their pavement needs; thus, funding can be sought through local agency sources as well as through the TIP. Accurate management of the multibillion-dollar roadway infrastructure is essential for allocating and optimizing the impact of available transportation funding.



Seattle, WA: Puget Sound Regional Council

To help quantify the need for additional funding, a number of MPOs are looking at data-driven approaches for documenting the condition and investment needs of routes that serve as major corridors for commerce and traffic. The Puget Sound Regional Council, the MPO for the Seattle, WA, urbanized area, is creating a database that includes pavement conditions for local major and minor arterials throughout the four-county region. This database (a) is designed to help decisionmakers understand the magnitude of investment needed to maintain the region's local arterial network, (b) incorporates pavement data collected by Washington State Department of Transportation, and (c) is linked to a geographic information system. The geographic information system includes information on responsible jurisdiction, number of lanes, segment lengths, functional classification, and pavement type.

This database will provide the Puget Sound Regional Council a means to characterize local arterial needs and expenditures over the life of its metropolitan transportation plan (MTP) for all municipalities and jurisdictions therein, while providing the State legislature with an accurate and meaningful data set that illustrates future funding needs dedicated to system preservation.

Albany, NY: Capital District Transportation Committee (CDTC)

The Capital District Transportation Committee (CDTC), the MPO for the Albany, NY, urbanized area, places a strong emphasis on maintaining the region's transportation infrastructure. CDTC's MTP for the region, the New Visions Plan, uses a performance-based management strategy that instructs to paint bridges before they corrode, build long-lasting pavements, and match treatment to road function. Projects selected to be on the TIP are screened to ensure the greatest life-cycle benefit. Public transit, sidewalks, and bicycle facilities are included in the consideration.

Both MTP and TIP rely on extensive pavement- and bridge-condition data, and since 1983, CDTC has conducted regular surveys of the condition of the region's non-State, Federal-aid roads and portions of the local non-Federal aid system. The condition survey information collected is used to determine system-level condition, estimate overall deterioration rates, calculate costs to rehabilitate the system, and determine the effects of various repair strategies on pavement serviceability. Together with similar surveys conducted by local municipalities and by the New York State Department of Transportation, these surveys help form a complete picture of the condition of all roads in the region.

CDTC also maintains a congestion-management system plan that insists on demand management and local land-use management agreements as a prerequisite to capacity work. The development of a regional safety-management system, now underway, not only supports the continued use of traditional countermeasures, but also encourages the use of innovative design treatments that reduce the risk for the region's most vulnerable users, namely cyclists, walkers, children, and the elderly.

CONCLUSION

A TAM approach can provide valuable information for the planning, programming, and overall management of the transportation network. Information from management systems is essential in transportation decisionmaking to establish realistic agency goals, thus setting investment levels across assets, which include transportation system safety, operations, preservation, and maintenance, and selecting priorities for State TIP preparation. To successfully manage transportation assets, transportation organizations that include planning organizations should have a clear role in understanding and utilizing the information provided by management systems to make informed decisions.

This document was prepared by the U.S. Federal Highway Administration (FHWA) with expert guidance provided by Patricia A. Cazenas, P.E., L.S., and Nastaran Saadatmand, P.E.

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For more information on planning and asset management, please visit the following Web sites:

AASHTO Asset Management Self Assessment Guide
http://www.tfhrc.gov/focus/dec03/04.htm

Performance Measures and Targets for Transportation Asset Management
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_551.pdf

Integrating Asset Management into the Metropolitan Planning Process: A Peer Exchange
http://www.fhwa.dot.gov/hep10/state/intassetindex.htm

Congestion Management Systems
http://www.fhwa.dot.gov/resourcecenter/teams/planning/cms.cfm

GIS and Transportation Planning
http://www.gis.fhwa.dot.gov/reports.asp

Transportation Planning and Capacity Building
http://www.planning.dot.gov/default.asp

Traffic Management Systems
http://www.fhwa.dot.gov/tfhrc/safety/tms.htm

FHWA Office of Asset Management
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