

A STRATEGIC FRAMEWORK TO SUPPORT THE IMPLEMENTATION OF TRANSPORTATION ASSET MANAGEMENT IN STATE TRANSPORTATION AGENCIES

DEVELOPED BY THE TRANSPORTATION ASSET MANAGEMENT EXPERT TASK GROUP (TAM ETG)

Introduction

Managing highway assets effectively has become increasingly challenging as transportation agencies deal with aging infrastructure assets, increased demand on the system, higher customer expectations, and a widening gap between investment needs and available resources due to the lack of gas tax increases in recent years. Further adding to their trials is increased pressure on government agencies to make decisions more transparent and to improve agency accountability for investment decisions. As a result, transportation agencies have re-evaluated how they manage the transportation system and have adopted innovative strategies that have resulted in a shift from focusing on system expansion to more of an emphasis on system preservation. For many agencies, this led to the implementation of transportation asset management (TAM) principles for making strategic investment decisions that preserve physical highway assets, recognize customer expectations, and consider the long-term financial implications of different preservation strategies on system performance. The Federal Highway Administration (FHWA) the American Association of State Highway and Transportation Officials (AASHTO), and the Transportation Research Board (TRB) have supported the implementation and use of asset management through the development of guidelines and tools that help agencies address the technical and organizational issues associated with this shift in agency priorities.

On July 6, 2012 new highway legislation was signed into law that has further strengthened the interest and involvement in asset management. This legislation, which is commonly known as the “Moving Ahead for Progress in the 21st Century Act”, or MAP-21, funds transportation programs for fiscal years 2013 and 2014. In addition to providing funding, the legislation establishes a performance-based Federal highway program that focuses on national transportation goals, increases the accountability and transparency of the Federal highway programs, and supports the use of performance data to drive investment decision making.

One of the provisions of the legislation is a new obligation requiring States to develop “a risk-based asset management plan for the National Highway System (NHS) to improve or preserve the condition of the assets and the performance of the system.” The Transportation Asset Management Plan (TAMP) is to include investment strategies that will “lead to an improvement program that enables the State to make progress towards State performance targets and that supports progress towards national goals.” Although the legislation only requires the TAMP to include pavement and bridge assets on the NHS, the legislation encourages States to include all infrastructure assets within the right-of-way corridor in their plan.

In light of the increased interest in asset management, and the Federal support for the use of asset management principles in managing a highway network, the FHWA formed a Transportation Asset Management Expert Task Group (TAM ETG) to identify outreach activities and other initiatives that will further increase the awareness of asset management among state highway agencies and advance the implementation and use of asset management principles. The TAM ETG was formed in March 2012 and its members developed the following charter to define its mission:

The TAM ETG will:

- Outline a framework for financially sustainable infrastructure and service delivery, connecting asset management, stewardship, risk management, performance management, and long-term financial planning;
- Identify strategies to advance asset management practice; influence change within state DOTs; promote partnering with transportation agencies; and address gaps in current policies, guidance, and practices related to TAM framework, roles and responsibilities, drivers, tools, and/or workforce skills;
- Provide input to FHWA, AASHTO, and TRB in terms of the direction, definitions, processes, tools, and templates associated with the implementation of transportation asset management plans in state DOTs;
- Develop and implement a plan for communicating the work of the TAM ETG to the transportation community;
- Establish a forum to sustain the work and continue the role of this group.

Since the time the charter was developed, the TAM ETG has been active in a number of outreach activities in support of asset management. Most recently the TAM ETG sponsored a Transportation Asset Management Book Club, which featured a series of webconferences that cover each of the chapters included in the AASHTO *Transportation Asset Management Guide – A Focus on Implementation*. The TAM ETG also supported the development of presentations and videos for agency executives and a framework for a knowledge portal that is being developed under a National Cooperative Highway Research Program (NCHRP) project.

This document summarizes the recommendations of the TAM ETG for the type of support needed to advance the implementation of asset management in State transportation agencies in the future. The recommendations include an endorsement for continuing the work of the TAM ETG as a source of on-going feedback and support to FHWA, AASHTO, and TRB as these agencies develop strategy, policy, technical guidance, and implementation actions related to asset management.

Advancing the Use of Asset Management

Asset Management Overview

Asset management has been defined in a number of different ways, but most definitions recognize that asset management guides investment decisions for physical transportation assets by considering the long-term impact of investment strategies on system performance over the life of the assets. For that reason, the TAM ETG supports the definition of asset management that was included in the MAP-21 legislation. It states that:

The term “asset management” means a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based on quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the lifecycle of the assets at minimum practicable cost.”

Asset management fits within a performance management framework, which the FHWA's Office of Transportation Performance Management defines as “a strategic approach that uses

system information to make investment and policy decisions to achieve a desired set of national goals.” Performance management includes the performance of the physical assets managed using transportation asset management principles, but also addresses agency efficiency and other services provided by the organization to fulfill its strategic objectives. As part of its work, the TAM ETG contributed to the development of a 2013 AASHTO publication titled “The Relationship Between Asset Management and Performance Management” to help clarify the interactions between these two programs.

At a minimum, asset management results in performance-based investment decisions that lead to the long-term, cost-effective maintenance, preservation, rehabilitation, and reconstruction of physical assets. At its fullest, asset management investment decisions lead to strategies that enhance asset value, reduce agency risk, preserve and renew asset conditions, and reduce the whole life costs associated with asset preservation so they provide the level of service needed to meet agency mobility, safety, infrastructure condition, and environmental objectives.

Asset management supports many of the functions in a transportation department, as illustrated in figure 1. This figure illustrates that the TAMP required under MAP-21 links the agency’s long-term strategic goals with shorter-term plans (such as the Statewide Transportation Improvement Program [STIP] or the Transportation Improvement Program [TIP]) and the delivery of transportation services as outlined in the Annual Plan. It further illustrates the importance of considering agency and program risks in developing these investment strategies.

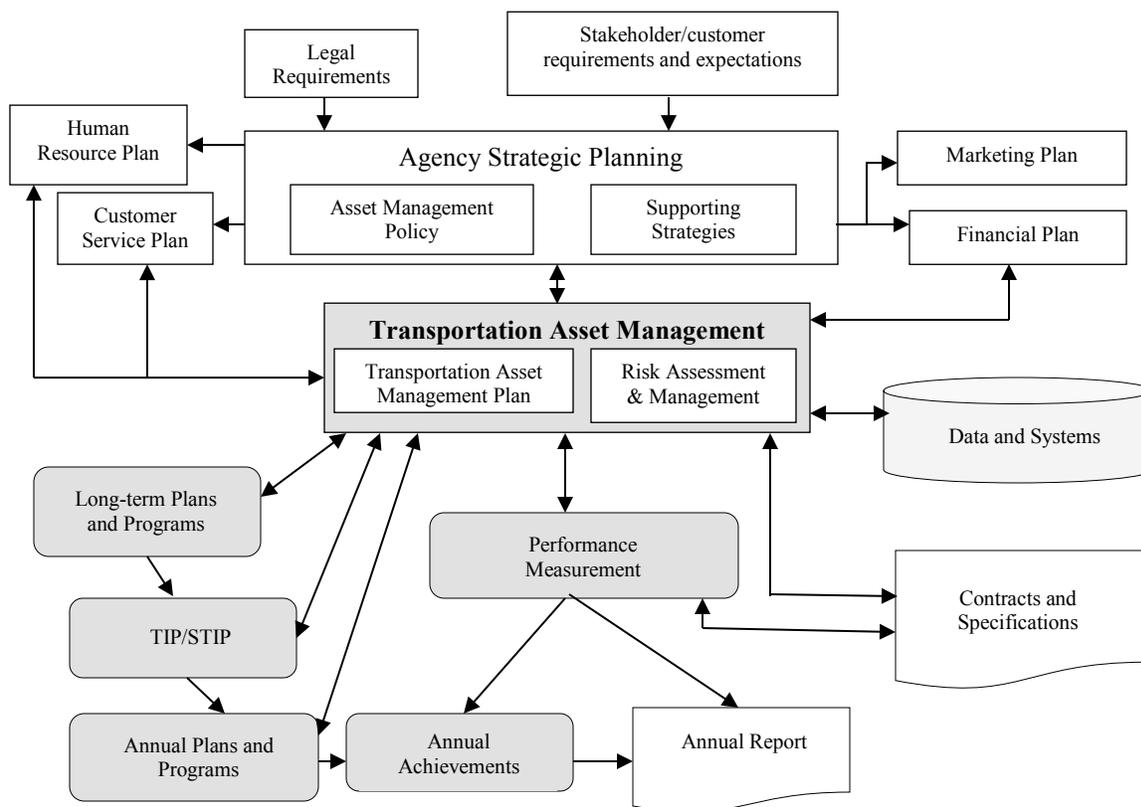


Figure 1. Asset management links to other agency functions (modified from AASHTO 2011).

To be successful, asset management needs to be embedded into an agency's business processes at all levels, including the strategic level, where policies and agency goals are established, the tactical level, where the impacts of different investment levels are evaluated for preparing multi-year programs, and the operational level, where annual plans and programs are implemented in the field. Performance measures provide the link between each level by helping to ensure that investment levels are aligned with agency goals and priorities. By monitoring activities that lead to improvements in high-priority areas, an agency has a higher likelihood of accomplishing its overall goals because objectives are clear and investment decisions are aligned. This relationship is illustrated in figure 2.

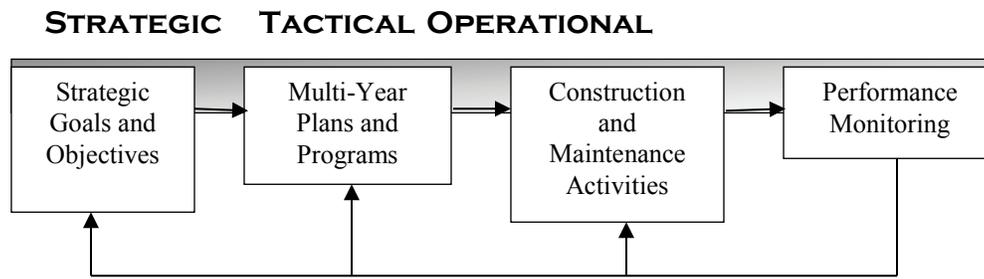


Figure 2. Alignment of agency decisions.

Asset management provides agencies with a systematic approach to managing transportation agencies that improves agency transparency and accountability. It is based on the following five basic principles:

1. **Policy-driven:** Decisions reflect policy goals and objectives that define desired system performance levels.
2. **Performance-based:** Performance information is used to establish target levels, to allocate funding, and to monitor progress.
3. **Evaluates options:** Comprehensive choices and tradeoffs are examined at each level of decision-making.
4. **Data driven:** Management systems and tools that utilize quality data are used to support decisions.
5. **Transparent:** There are clear criteria for making decisions.

The systematic process focuses on decisions that support a long-term vision for a financially-sustainable program that considers the whole-life costs of preserving asset value and provides for a defined level of service that considers economic realities, anticipated changes in system demand, and risk. This systematic process for managing infrastructure assets enables agencies to provide services in a cost-effective manner and to demonstrate to the public, to elected officials, and to other stakeholders that available resources are being used wisely.

Many transportation agencies adopted asset management principles prior to the passage of MAP-21 because it represents a “better way of doing business.” The unique combination of aging infrastructure and increased competition for funding served as a catalyst for a number of agencies to shift the focus from system expansion to an increased emphasis on asset preservation. As a result of this shift in philosophies, there have been subsequent changes in agency culture and an increased focus on performance-based investment decisions that emphasize a whole-life approach to managing assets. As shown in figure 3, this new business model reduces the overall cost of

maintaining assets over their life and often results in higher performance levels and improved customer satisfaction. A focus on costs over the life of an asset also accounts for future maintenance requirements associated with each new asset, recognizing that if funding for future maintenance expenditures for the new asset is not accounted for, the service level of the rest of the system will be lowered to account for these unplanned expenditures.

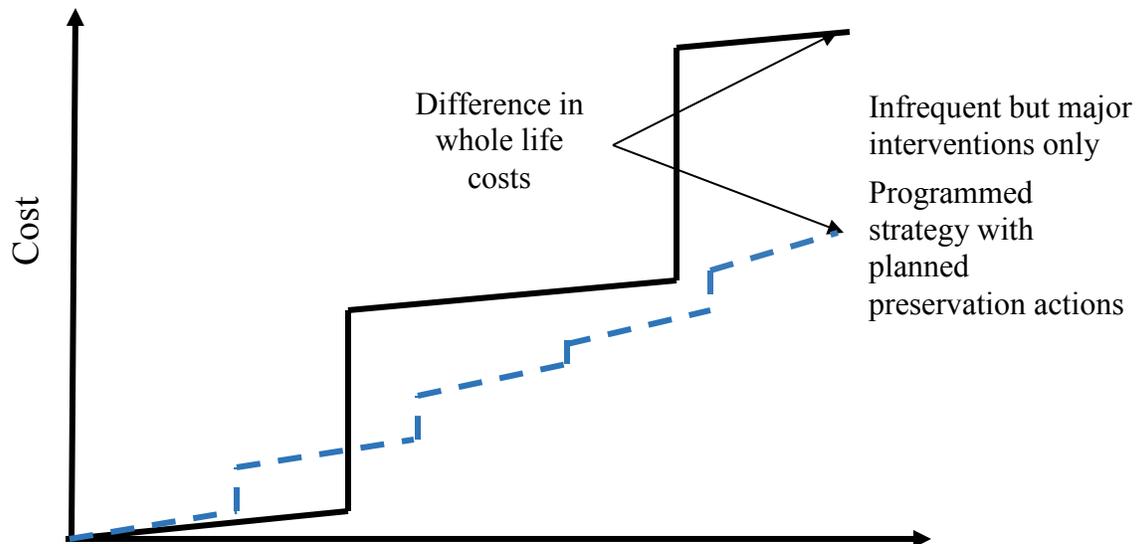


Figure 3. Reduction in whole-life costs associated with asset preservation.

An Asset Management Framework

An asset management culture is prevalent in many countries internationally, including Australia, England, and Scotland. For the most part, these countries were driven to adopt an asset management philosophy for many of the same reasons that are impacting transportation agencies in the United States. In Australia, the Institute of Public Works Engineering Australia (IPWEA) views the sustainable management of the infrastructure as a balance between stewardship (responsible management), asset management planning (preserving existing assets as well as adding new assets), and long-term financial planning (moving towards sustainability and long-term considerations). Therefore, a significant proportion of the IPWEA's efforts have been focused on creating a national framework for the consistent application of these principles, providing the tools needed to implement the framework and establishing drivers that create incentives for using these principles effectively.

The FHWA's TAM ETG has adopted a modified version of the IPWEA framework as the basis for evaluating current practices in asset management and developing recommendations that advance the use of asset management principles in state transportation agencies. As shown in figure 4, the TAM ETG framework illustrates the importance of balancing each of the three components to achieve more financially-sustainable highway systems in the United States. The first component, asset management planning, involves the development of a TAMP that clearly identifies performance targets and investment strategies. The TAMP also includes the second component, which is a long-term financial plan that considers strategies to reduce the life cycle cost of managing assets and that takes into account future maintenance needs associated with capital projects. The third component of the framework addresses stewardship, which involves accepting responsibility for meeting customer expectations and preserving the value of transportation assets that are available to both current and future generations. Responsibility for stewardship resides at all levels of a transportation agency, and it extends outside of the agency

to include the FHWA and other stakeholders who influence transportation policy and funding. The framework for building sustainable highways in the United States is illustrated in figure 4.



Figure 4. The proposed TAM ETG framework for building more sustainable transportation systems.

Building on this framework, the TAM ETG summarized some of the key initiatives that have been undertaken to advance the use of asset management in state transportation agencies. These activities, which are summarized broadly in table 1, capture some of the recent accomplishments that have been initiated to build stewardship, to support asset management planning efforts, and to establish guidance for long-term financial planning. Collectively, these activities have helped to create a consistent framework for asset management, to build organizational capacity and useful tools for the implementation of asset management, and to promote the use of asset management in state transportation agencies.

As illustrated in the table, there have been a number of initiatives in recent years that have been targeted towards the increased use and understanding of asset management principles in state transportation agencies. However, as documented in a recent synthesis of state practice, there are few agencies that are fully using asset management as the basis for making agency investment decisions. Therefore, the remainder of this document focuses on establishing a better understanding of current practices in asset management and identifying strategies to address any gaps that exist between current and desired practices.

Current Practices

The financial impact of asset management touches every aspect of an organization and even with the potential positive benefits, changing a transportation agency's culture to initiate, embrace, and ultimately integrate transportation asset management principles into the decision making process is still a considerable challenge. Although the emergence of champion agencies using TAM principles was limited in the past, the level of interest among state DOTs, federal agencies, professional organizations, and the research community has been steadily increasing. As an example, the 9th National Conference on Transportation Asset Management (April 2012, San Diego, CA) had over 320 attendees and 34 states represented. In addition, the recent congressional passage of MAP-21 is expected to serve as a catalyst for agencies to adopt TAM principles given that it establishes an outcome-driven approach that tracks performance and will hold states and metropolitan planning organizations (MPOs) accountable for improving the condition and performance of their transportation assets and for meeting community performance objectives.

Table 1. Examples of recent activities to support the implementation of asset management in state highway agencies.

	Activities Supporting the Development of A Consistent Framework for Asset Management	Activities Building Organizational Capacity and Useful Tools for Asset Management	Drivers Promoting the Use of Asset Management
Building Stewardship	Asset management video and PowerPoint being developed as a TAM ETG outreach effort	AASHTO <i>Transportation Asset Management Guide: A Focus on Implementation – Executive Guide</i> <i>Executive Strategies for Risk Management by State DOTs</i>	MAP-21 legislation and the establishment of national goal areas
Supporting Asset Management Planning Efforts	AASHTO <i>Transportation Asset Management Guide: A Focus on Implementation</i> FHWA TAMP Development Pilot Project – Work plans and other products available on the FHWA website Guidebook on Agency Risk Management Strategies, Methods, & Tools (to be developed) Cross-Asset Resource Allocation and the Impact on System Performance Guidelines (under development)	National Highway Institute Training AASHTO/FHWA Webinar Series FHWA/AASHTO Book Club Synthesis of Asset Management Practices in State Highway Agencies Gap Analysis Tool TAMP Templates Successful Practices in GIS-Based Asset Management	MAP-21 requirements for state performance targets and development of a long-term, risk-based asset management plan
Supporting Long-Term Financial Planning Efforts	FHWA Webinar: Performance Measures for Financial Sustainability of Highway Assets FHWA Workshops on Long-Term Financial Planning to Support TAM (October 2013)		

Given the growing level of interest from transportation agencies in TAM and the new performance-based legislation, NCHRP initiated a synthesis of transportation asset management practice among state highway agencies to serve as a timely resource documenting the state of the practice. A total of 43 state highway agencies responded to the survey. The results are published in NCHRP Synthesis 439, *Use of Transportation Asset Management Principles in State Highway Agencies* (2013).

Synthesis Findings

The DOT summary of practice (based on the Synthesis 439) was developed and categorized according to the basic components of an AM system, which include the following:

Organization – 60 percent of the state DOTs that responded to the synthesis have an asset management group. Even though major asset managers (pavements and bridges) dominate the composition of these groups, planning and top executives are included in 30 percent of the asset management groups. These groups most often reside across divisions/offices which imply no formal asset management unit within the DOT; however, four state DOTs have created separate divisions within their organization to support asset management activities.

Having an asset management group, executive involvement, and an asset management structure within the organization is critical to supporting asset management activities covering development, implementation, and practice. Some agencies have a more structured approach to the group with defined functions while others provide general guidance and support. A good example of a structured group is the Michigan Department of Transportation. Their Transportation Asset Management Council (TAMC) is a legislated body of representatives from agencies who own roads and bridges or are responsible for road funding; representation is from all levels of government in Michigan.

Data - Asset management represents a strategic approach towards managing infrastructure assets that places a premium on comprehensive and credible information across the agency. The integration of TAM principles requires knowledge about the number and condition of each asset managed by the agency.

In recent years, asset management inventories have expanded beyond the traditional pavement and bridge assets, which all DOTs have information on, with over 70 percent of the state DOTs indicating that they collect inventory information for signs, guardrail, culverts, and lighting structures. In addition, over 50 percent of the agencies are conducting condition assessments on those assets beyond pavements and bridges, which allow a more comprehensive investment analysis for project selection and resource allocation recommendations.

The importance of having reliable information for managing assets is conveyed by the FHWA in a report available on its website¹. The report states that “data collection, data management, and data integration are essential parts of the Asset Management framework that are critical to its success and utilization within a highway agency. Timely and accurate data lead to information and form the basis for effective and efficient decision making.”

The success and maturity of any asset management process relies on the identification of primary asset management data needs across the organization. Of the responding DOTs, 28 out of 42 (67 percent) had completed this effort. This is an area where agencies need support to complete this critical activity. Identifying data needs to support asset management practices streamlines the data collection process, minimizes collection costs and allows agencies to plan and allocate staff resources to accommodate access and integration needs. Assuring the quality of these data entails evaluating the data integrity, accuracy, and validity. A total of 31 State DOTs (74 percent) reported that they have a process in place to assess the quality of the collected data.

Decision making - Over 70 percent of the responding agencies noted that using asset management principles has made their decisions more data driven, defensible, and performance-based. Sixty percent of the agencies are balancing asset management decisions regarding preservation and capital improvements, which is a critical component for developing a sustainable infrastructure. Fifty percent of the agencies have developed a process to share asset management information with elected and appointed officials, which is

¹ Federal Highway Administration, Asset Management Data Collection for Supporting Decision Processes, FHWA, Washington, D.C., 2009 [Online]. http://www.fhwa.dot.gov/asset/dataintegration/if08018/assetmgmt_web.pdf

helpful for communicating investment needs and adding transparency to the decision-making process by presenting the results of a trade-off analysis.

Even though 70 percent of state DOTs are collecting data beyond pavements and bridges, they still need to expand the use of this information in the decision-making process. For example, more than 90 percent of the agencies use asset management information to select bridge and pavement projects; however, for other asset decisions (e.g., maintenance, operations, and safety) this number drops below 40 percent.

Performance measures and risk - The primary performance measures that drive agency decision making include either physical condition (98 percent) or safety (90 percent). However, more than half of agencies reported both operations (57 percent) and capacity (50 percent) as decision-making drivers. Only 27 percent of the respondents incorporate risk into their short-term decision making, which is normally associated with cost and schedules. Only 19 percent of the responding agencies consider long-term risk in their decision making, which includes design, sustainability, and climate change. With the passage MAP-21, state DOTs and other transportation agencies have to focus more on incorporating risk as part of the decision making process, so this is an area where agencies are going to need training, tools, and proper data to support risk management.

TAMP - A TAMP is an essential management tool that brings together all related business processes and stakeholders, internal and external, to achieve a common understanding and commitment to improved performance. It is a tactical-level document, which focuses its analysis, options development, programs, delivery mechanisms, and reporting mechanisms on ensuring that strategic objectives are achieved.²

Although many state agencies say they are practicing TAM, only a very limited number have completed TAMPs that contain all of the components described in the 2011 AASHTO *Transportation Asset Management Guide: A Focus on Implementation*. As part of the synthesis survey, 14 state DOTs said that they would provide a copy of their TAMP to be analyzed. However, only five ended up providing a document, and of those five agencies, only two (New Jersey and Georgia) provided TAMPs that incorporate most of the essential components of a plan. The remaining three agencies provided more of an implementation plan, or a strategic plan, to improve the practice of asset management at the agency. Regardless, the content of these plans is encouraging; they focus on more than just pavement and bridges, and consider integration, communication, and effective decision making. When discussing the TAMP with other agencies that didn't provide documents, it was evident that even though they said they have a TAMP, a single document that meets the definition outlined in the AASHTO *Guide* did not exist. Rather, most agencies could find parts of the TAMP in existing documents located in different offices throughout the organization.

TAMP Development

Since the passage of MAP-21, the FHWA initiated a pilot study to assist three states (LA, MN, and NY) with the development of their TAMP so the results can be used to help other agencies with this important task. The work plans developed by each of the three states are available on the FHWA website (<http://www.fhwa.dot.gov/asset/plans.cfm>) and as other products are

² American Association of State Highway and Transportation Officials (AASHTO), *Transportation Asset Management Guide: A Focus on Implementation*, AASHTO, Washington, D.C., 2011.

developed under this study the material will be posted for other agencies to reference. In addition to the FHWA effort, numerous state DOTs have either started developing their TAMP using inhouse staff or are hiring an outside contractor to facilitate meetings and to help draft the plan.

In addition to the focus on preparing TAMPs, a number of transportation agencies are using their TAMP development process to identify changes in existing business processes that need to change to better support asset management. For example, the New York State Department of Transportation is focusing on strategies that improve the system as a whole, rather than focus entirely on individual projects. This has led to the identification of changes needed to existing planning and programming processes as well as contracting mechanisms.

In addition, transportation agencies are considering agency risk as they identify system improvements. Moving beyond the consideration of project risks (such as those designed to control project costs, scope, and schedule) allows an agency to identify the factors that could prevent the agency from reaching its objectives. A formal risk management process not only identifies the risks the agency faces, but also evaluates them in terms of likelihood and consequence, and develops strategies for mitigating the most significant risks.

Implementation Challenges

One of the keys to advancing asset management practices in state DOTs lies in identifying and addressing the primary barriers that hinder its development and implementation. Common challenges to asset management include institutional and organizational factors, data collection and measurement, data integration and decision making, availability of tools and analytical capabilities, and the need for training and technology transfer for workforce development.

To gauge the challenges faced by the state DOTs, participants in the synthesis survey were asked to identify the major barriers faced in the development and implementation of their asset management processes. Table 2 shows that the lack of agency resources was the primary barrier faced by the DOTs, followed by resistance to change, and inter-departmental interactions. Twenty two agencies (51 percent) identified a lack of expertise and the need for training as a major challenge, indicating a need for additional training support at all levels. Fourteen agencies (33 percent) selected executive commitment as a barrier to implementing asset management. Based on what was discussed earlier regarding organizational structure, support from the executive level had a positive effect on the utilization of asset management practices. Only two (5 percent) of the responding agencies noted that a lack of guidance and support from FHWA and/or AASHTO was considered a barrier towards progress (Note: this survey was completed prior to the passage of MAP-21 so the response to this question could be very different today). These challenges identified by each agency will serve as a resource in targeting and advancing AM support activities.

Table 2. Challenges to AM development and implementation (from NCHRP Synthesis 439).

Challenges	Responses*	Percent
Lack of resources (e.g., funding, equipment)	35	81 %
Lack of staff	29	67 %
Resistance to change	26	60 %
Inter-departmental interactions	25	58 %
Higher and other priorities	22	51 %
Lack of expertise and training	22	51 %
Staff commitment	18	42 %
Executive commitment	14	33 %
Staff turnover	11	26 %
Availability of adequate tools in the marketplace	9	21 %
Outside pressure to have a subjective approach	8	19 %
Lack of guidance and support	2	5 %

*43 agencies responded, but multiple answers were allowed.

The top challenges identified from the synthesis, including the lack of resources and staff, can be classified as symptoms associated with a lack of strong top-level commitment for asset management within the agency. As evidenced in states with particularly strong support for asset management at the executive levels, even agencies with tight funding constraints have been able to realign resources to address asset management objectives. Other challenges, such as “higher and other priorities” and “staff/executive commitment,” may be lessened now that MAP-21 legislation is in place. Over time, the beneficial effects of this better way of doing business may also help to overcome these types of challenges.

Asset management implies change, and change in an organization can be difficult to deal with. This is shown in table 2 since “resistance to change” and “departmental interactions” ranked third and fourth as top challenges to the implementation of asset management. To address that, state DOTs and other transportation agencies have to consider the following:

1. Organizational and institutional changes in asset management will likely present greater challenges than changes in technical or analytic capabilities. Involvement/buy-in from different groups is going to be essential to move the asset management process forward.
2. Collaboration is a key to establishing strategies that can be put in place to bring about change more effectively, by establishing support and confidence among managers and staff along the way and at different levels of the organization.
3. Open communication is essential both internally and externally to explain the asset management program. An asset management program:
 - a. Can improve understanding by taking some of the mystery out of how and why decisions are made.
 - b. Can improve confidence in agency performance by clearly reporting achievements-and failures-and progress toward established goals.

- c. Clearly defines, communicates, and links performance measures to the agency's vision and mission so that they have meaning to its customers.
- d. Requires a cultural change. Senior leadership and management must be committed to the principles of asset management and to providing the resources to implement it.

Another type of organizational issue that needs to be addressed is the “lack of expertise and training.” According to the synthesis survey, more than 50 percent of the participating DOTs reported the lack of expertise and training as a barrier. FHWA and its National Highway Institute (NHI) have been working together in recent years to develop training classes to support the state DOTs and other agencies efforts to develop and implement asset management practices. NHI offers two classes on asset management: a class to introduce the concepts of asset management and a class on developing a TAMP. NHI also offers classes on risk management and assessment. Additionally, FHWA has developed a data integration primer (available at <http://www.fhwa.dot.gov/asset/dataintegration/if10019/dip00.cfm>) to help state DOTs with the data challenges described above. Other resources available through FHWA and AASHTO, such as webconferences on asset management, are also available to help agencies build organizational capacity and individual expertise in asset management.

Gaps (Issues)

Using the results of the synthesis as a base, the TAM ETG identified a variety of factors that limit the ability of state highway agencies to fully utilize asset management. These gaps, which are listed below, range from the availability and capacity of agency employees to the availability of the processes and tools to support an asset management analysis.

- **Agency resources:** The availability of agency resources to support asset management activities is limited and many agencies are not filling vacancies that are created.
- **Agency awareness, knowledge, and understanding:** Asset management represents a new way of doing business, which requires new skills and changes to the types of individuals being hired in transportation agencies.
- **Public understanding:** The common approaches to communicate funding needs have not addressed funding needs in transportation. Additionally, the long-term consequences of deferring asset preservation activities are either not understood or are being ignored.
- **Stewardship:** More elected officials and agency executives need to be made aware of their role as stewards of transportation assets. As a result, they do not place a priority on preserving the value of these assets over time.
- **Organizational culture:** Since these agencies were created, state and federal transportation agencies have primarily focused on expanding and rehabilitating the highway system. Today's economic climate demands that transportation agencies change the organizational culture to support the new way of doing business. These changes involve transitioning from a culture focused on system expansion to system preservation and placing more of an emphasis on system optimization over project optimization.
- **Leadership support and commitment:** Asset management demands the support and commitment of agency leadership in setting policies and investment priorities. Executive support is also instrumental in facilitating the business process and other organizational changes needed to build an organizational culture that supports performance-based decisions.

- **Funding structure:** Historically, transportation funding has been allocated into a number of different formula programs, each of which has their own requirements for using funds. MAP-21 places more of an emphasis on managing to performance outcomes that are documented in the TAMP. MAP-21 also consolidates the funding for some programs, but the remaining programs can influence the amount of flexibility that state highway agencies have in making asset management investments. Changes in existing federal and state policies may also be needed to support investments that optimize system performance rather than focus on optimizing project performance.
- **Data and Systems:** In the past, agency personnel collected the data they needed to make investment decisions independent of other uses for the data. Efforts to improve agency efficiency are forcing transportation agencies to coordinate data collection efforts and to strive for consistent data standards so data can be integrated on an agency-wide basis. Advances in technology have significantly improved data coordination and integration efforts. However, some of the existing technology is under-utilized. In other instances, analysis tools have not yet been developed to provide some of the capabilities desired in using and analyzing available data.
- **Risk Management:** MAP-21 requires the consideration of risk in developing an asset management plan. Although most transportation agencies have accounted for risks on individual projects, the systematic consideration of agency and program risks is a new concept that is not well understood. Among agencies that have considered risk, there is no consistent approach being used. Therefore, guidance is needed on how to better incorporate and use risk in making investment decisions.
- **Long-Term Financial Planning:** Internationally, transportation agencies have developed metrics leading to sustainable transportation systems through a focus on long-term financial plans that balance the trade-offs between anticipated revenue and the funding needed to achieve performance targets. These concepts are not widely understood or utilized within the United States.

To help identify strategies for addressing these gaps, the TAM ETG identified the following four contributing factors as having a significant influence on the implementation of asset management in state transportation agencies:

- Organizational capacity.
- External stakeholder influence.
- Availability of processes and tools.
- Financial management.

The resulting analysis of each of the gaps and the influence of these contributing factors is presented in table 3. As shown in the table, a significant number of the gaps are influenced by organizational capacity factors, indicating that addressing the organizational issues that state transportation agencies are facing will have the most significant influence on closing the gaps. It also became obvious that the availability of processes and tools that help agencies more fully utilize asset management principles would help to reduce some of the lack of understanding among agency personnel. Efforts such as the FHWA's pilot project to implement TAMPs in three highway agencies and to develop TAMP templates for other agencies to use is a good example of an existing initiative designed to address these gaps.

Table 3. Contributing factors influencing each gap area.

Gaps	Organizational Capacity	External Stakeholder Influence	Availability of Processes and Tools	Financial Management
Resources: Agency Resources	<ul style="list-style-type: none"> Staff shortages exist due to retirements and decisions not to fill vacancies The organizational structure does not easily accommodate cross-cutting activities Agency knowledge is retiring faster than it is built 	<ul style="list-style-type: none"> There is external pressure to reduce the size of government agencies 	<ul style="list-style-type: none"> Resources are not always available to maintain data and systems over time The benefits associated with improved data cannot easily be documented and conveyed to decision makers 	<ul style="list-style-type: none"> Work activities are contracted out due to staff shortages
Resources: Agency Awareness, Knowledge, and Understanding	<ul style="list-style-type: none"> Asset management is not part of a traditional engineering curriculum DOTs have not typically hired business majors Existing workloads limit the time available to acquire new skills 	<ul style="list-style-type: none"> Reasons for using asset management are not well known or understood beyond what is legislated 	<ul style="list-style-type: none"> Staff are not always aware of available tools and products Staff do not have the knowledge or experience to know what questions to ask or to evaluate the suitability of available tools and products 	<ul style="list-style-type: none"> Fiscal constraints are forcing agencies to be more efficient with available resources
Resources: Public Understanding	<ul style="list-style-type: none"> Benefits to improved asset management are primarily subjective rather than objective Agencies rely on traditional methods of conveying needs, which have not been effective at driving change 	<ul style="list-style-type: none"> The benefits of asset management are not well understood outside of the transportation community Consequences of deferring preservation activities are not well known Traditional measures of performance have not motivated decision makers in the past 	<ul style="list-style-type: none"> It is difficult to quantify the benefits associated with improved decisions or better data 	<ul style="list-style-type: none"> Long-term consequences of limited investments in transportation are not well understood or are not convincing
Leadership: Stewardship	<ul style="list-style-type: none"> Methods of conveying investment needs that lead to fiscally sustainable programs are not well understood There is little guidance available to help agencies strengthen their roles as system stewards 	<ul style="list-style-type: none"> Elected and appointed officials have not embraced their role as stewards of the transportation system MAP-21 requirements will lead to improved transparency and accountability 	<ul style="list-style-type: none"> Mandates for compliance with standards such as safety and handicap access are often based on highway project location instead of locations of greatest benefit 	<ul style="list-style-type: none"> Financial managers have not traditionally been involved in asset management activities
Leadership: Organizational Culture	<ul style="list-style-type: none"> Most agencies have a short-term rather than long-term focus Efforts of individual champions may start an initiative, but are not sufficient to sustain the initiative over time Asset management is cross-cutting and does not easily fit within existing organizational structures 	<p>Agency leadership changes after elections can have a significant impact on programs that are not fully integrated into business processes</p> <p>In the absence of strong stewards among elected officials, there is little incentive from external stakeholders to use asset management</p>	<ul style="list-style-type: none"> Some guidance is available to identify improvement areas through the self-assessment and gap analysis tools 	<ul style="list-style-type: none"> There are few known financial incentives to motivate agency change
Leadership: Leadership Support and Commitment	<ul style="list-style-type: none"> It is difficult to make the changes needed for asset management without leadership support Historically, legislated requirements have not had the "teeth" necessary to motivate organizational change 	<ul style="list-style-type: none"> Priorities of elected and appointed officials often work against asset management programs Many transportation agency directors serve at the pleasure of elected officials, which makes it difficult to enforce changes to existing investment processes 	<ul style="list-style-type: none"> There is a lack of executive-level metrics that communicate the need for, and the benefits of, preservation activities 	<ul style="list-style-type: none"> Transportation agencies facing constrained budgets are seeking ways of making more cost-effective investment decisions

Table 3. Contributing factors influencing each gap area (continued).

Gaps	Organizational Capacity	External Stakeholder Influence	Availability of Processes and Tools	Financial Management
<p>Planning and Programming:</p> <p>Funding Structure</p>	<ul style="list-style-type: none"> Dedicated funding sources lead to management of assets individually rather than as a system Traditional organizational structures do not easily lend themselves to cross-asset analysis Historically, there has been no accountability for reaching agency goals within planning and programming functions 	<ul style="list-style-type: none"> Transportation agencies have not traditionally been held accountable for stated performance objectives Unexpected events tend to divert funding away from sound, long-term goals 	<ul style="list-style-type: none"> The statewide transportation improvement program is managed on a project-by-project basis rather than a system optimization basis 	<ul style="list-style-type: none"> Dedicated funding sources prevent true optimization of investments Future funding levels are extremely variable, making it difficult to conduct long-term planning
<p>Data and Analysis:</p> <p>Data and Systems</p>	<ul style="list-style-type: none"> Leaders do not understand the value of improved data Data governance issues have not been addressed to identify data sources, uses, and standards Some people are hesitant to move forward without adequate data; yet obtaining adequate data can take years Agency staff do not have the skills to be able to fully utilize existing management systems Managing the system requires coordination with outside agencies, such as MPOs 	<ul style="list-style-type: none"> Elected officials and outside stakeholders seek improved methods of visualizing and communicating technical information 	<ul style="list-style-type: none"> Improved tools are needed to manage systems and to perform cross-asset utilization Tools to predict the performance of assets other than pavements are not widely available Many agencies have limited inventory and performance data on roadside assets, with the exception of pavements and bridges 	<ul style="list-style-type: none"> The lack of confidence in prediction models beyond 5 years makes long-term planning difficult
<p>Data and Analysis:</p> <p>Risk Management</p>	<ul style="list-style-type: none"> The structured analysis of agency and program risks is not well understood or practiced Guidance on conducting a formal assessment of agency risks is not available Legislation provides a basis for a consistent approach to be followed for analyzing and managing risk 	<ul style="list-style-type: none"> Demand for an agency-wide assessment of risks has been absent Unexpected events tend to shift funding away from sound, long-term goals 	<ul style="list-style-type: none"> There are not widely-available tools for conducting a formal risk assessment of agency and program risks 	<ul style="list-style-type: none"> Guidance for incorporating risk into long-term financial plans is not readily available
<p>Data and Analysis:</p> <p>Long-Term Financial Planning</p>	<ul style="list-style-type: none"> Organizational changes are needed to focus on long-term, sustainable investments in the infrastructure Concepts of long-term financial sustainability are not well understood in the United States Future funding is difficult to predict, making it hard to confidently plan into the future 	<ul style="list-style-type: none"> Political influence on program decisions can negatively influence an agency's ability to optimize expenditures and achieve goals In the United States, elected officials have not demonstrated an affinity for being held to long-term financial commitments There are no consequences for poor stewardship 	<ul style="list-style-type: none"> Guidance in developing long-term, sustainable programs is not currently available Existing systems may need increased sophistication to produce the information necessary for developing long-term, sustainable programs 	<ul style="list-style-type: none"> The links between the long-term financial plan and other operational plans is not well established

There are also a significant number of gaps related to external stakeholder influence and financial management that should be addressed to improve the long-term focus of asset management and to address the lack of public awareness associated with asset preservation investments. However, some of these issues are related to a broader transportation issue that would be nearly impossible to address without an effective public relations campaign targeted at elected officials and the general public.

Therefore, the TAM ETG developed a prioritized listing of gaps between current and desired performance. The list, which includes the items presented below, was used by the TAM ETG to identify both short- and long-term strategies for closing the gaps and advancing the implementation of asset management in state highway agencies, as discussed in the next section.

Short-Term and Long-Term Strategies to Address Gaps Identified by the TAM ETG

1. Focus short-term strategies on addressing the related to agency resources and leadership.
 - a. Build and strengthen leadership support for asset management programs that consider risk and that reduce the overall life-cycle cost of managing assets.
 - b. Improve the awareness, understanding, and knowledge of asset management at all levels of the organization.
 - c. Assist organizations with the cultural, organization, and institutional changes that are needed to advance the use of asset management.
 - d. Provide technical guidance and support in asset management so existing tools and data can be used fully and MAP-21 requirements can be met.
 - e. Encourage the use of asset management beyond the requirements outlined in MAP-21.
2. Focus long-term strategies on advancing asset management maturity levels and building external support for asset management.
 - a. Support the development of enhanced procedures and analysis tools that support cross-asset optimization, data integration, risk management, and long-term financial planning.
 - b. Demonstrate the influence of asset management on improvements in agency transparency, accountability, and stewardship.
 - c. Align national and state policies and standards with approaches that support the optimization of system performance.

Closing the Gaps

Addressing the short-term and long-term strategies listed in the previous section will require a coordinated effort involving federal agencies, technical associations, educational communities, practitioners, and others involved in asset management. These efforts require a focus on at least three important stages of implementation: building awareness, building capacity, and building guidance, tools, and templates to assist in the use of these new principles. The direction offered in table 4 establishes a timeline that address the organizational and technical issues that need to be addressed over the next 10 years. Specific activities that could be used in each of the three stages of implementation are presented separately in table 5.

Table 4. Focus areas over the next 10 years.

	Within the Next Two Years	Within the Next Five Years	Within the Next Ten Years
Focus Areas	<ul style="list-style-type: none"> • Implementation of MAP-21 	<ul style="list-style-type: none"> • Expanded coverage of assets included in a TAMP • Guidance on: Data Governance & Integration, Long-Term Financial Planning, Risk, System Optimization, Maturity Assessments • Level 3 Performance Measures 	<ul style="list-style-type: none"> • Expanded focus on Long-Term Financial Planning • Core maturity levels met in most states • Establish objective audit mechanism to ensure compliance with TAMP
Awareness Building Topics to Address to Achieve Desired Capabilities	<ul style="list-style-type: none"> • Asset Management • Developing a TAMP • MAP-21 Requirements • Communication Strategies • Risk Management • Data Integration 	<ul style="list-style-type: none"> • Long-Term Financial Plans • Maturity Assessments • System Optimization • Advanced Communication Strategies 	<ul style="list-style-type: none"> • TAMP Audit Mechanisms • Public support for asset management
Capacity Building Topics to Address to Achieve Desired Capabilities	<ul style="list-style-type: none"> • Developing a TAMP • Evaluating State TAMP Processes (FHWA Division Offices) • Aligning TAMP with agency long-range plans and processes 	<ul style="list-style-type: none"> • CEO Stewardship Roles • Enterprise Risk Management • Data Governance and Integration using GIS • Maturity Assessments • System (e.g. Cross Asset) Optimization 	<ul style="list-style-type: none"> • Long-Term Financial Planning • TAMP Audit Procedures • Level of Service Planning
Development of Guidance, Tools, and Templates to Achieve Desired Capabilities	<ul style="list-style-type: none"> • Data Collection and Management of Roadway Assets Other than Pavements and Bridges • TAMP Templates • Maturity Assessment Tools • Knowledge Portal 	<ul style="list-style-type: none"> • Risk Management Guidelines • System Optimization Tools and Strategies • Data Governance Guidelines • New and Enhanced Performance Measures 	<ul style="list-style-type: none"> • Financial Management Templates and Tools

Table 5. Suggested activities for each stage of implementation.

Implementation Stage	Suggested Activities
Awareness Building	<ul style="list-style-type: none"> • Webconferences • Conference presentations and workshops • Peer exchanges • Involvement with AASHTO and TRB committees and subcommittees (especially the Standing Committees on Planning, Highways, and Performance Management) • Practice notes and case studies • Regional calls and visits
Capacity Building	<ul style="list-style-type: none"> • Knowledge portal • Training (both online and instructor-led) • Webconferences • Peer exchanges • Practice notes and case studies • Scan tours • Targeted training and implementation guidance for lagging agencies • Expert technical assistance
Development of Guidance, Tools, and Templates	<ul style="list-style-type: none"> • Research studies • Pilot studies • Handbooks and guides • Templates • Software programs

Roles and Responsibilities

As discussed earlier, responsibility for enhancing the implementation and use of asset management is a shared responsibility among many different agencies and individuals. The primary focus for the TAM ETG was on assigning roles and responsibilities to FHWA, AASHTO, and TRB. In addition, the TAM ETG recommends continuing its efforts to offer support and guidance regarding implementation strategies and focus areas to advance the state-of-the-practice. Specific roles and responsibilities for each of these four groups are outlined below.

FHWA

The primary role of the FHWA in supporting asset management is to provide technical support and guidance to build awareness and to support agencies' efforts to build capacity. Therefore, FHWA roles and responsibilities include the following activities:

- Support regional and national outreach activities that build awareness among state practitioners, including regional calls and visits, webconferences, and conference presentations.

- Lead regional and national outreach activities that build awareness and agency capacity within FHWA Division offices.
- Conduct other outreach activities that support the implementation of the strategic recommendations included in this document.
- Provide technical and financial support for outreach activities that build agency capacity, including training courses, peer exchanges, scan tours, case studies, and expert technical assistance contracts.
- Provide technical and financial support for outreach activities to build agency capacity in lagging states, including obtaining top-level buy-in for asset management.
- Tie the recommendations from this document to the FHWA Strategic Implementation Plan to help build internal organizational support for the programs suggested.
- Continue to participate in AASHTO and TRB asset management activities.

In addition, FHWA technical and financial support is recommended for the continued work of the TAM ETG, including travel reimbursement for members and administrative support for a contractor to facilitate meetings.

Finally, since the FHWA serves a key role in supporting technical developments in the area of asset management, membership on technical panels, TRB committees, and other similar activities is a critical responsibility for FHWA personnel.

AASHTO

As a nonprofit, nonpartisan association representing transportation departments in 50 states, the District of Columbia, and Puerto Rico, AASHTO serves as a liaison between state Departments of Transportation and the Federal government. Its primary goal is to foster the development, operation, and maintenance of an integrated national transportation system by promoting promising practices and providing technical assistance. Members serve on standing committees and subcommittees to review existing and proposed policies, Federal laws, guidelines, and regulatory mandates. When deemed timely and necessary, the Standing Committees make recommendations to the AASHTO Board of Directors regarding policy actions.

To enhance the implementation of asset management practices, the TAM ETG recommends that strong advocates of asset management be nominated to serve on the Standing Committee on Highways (SCOH), the Standing Committee on Planning (SCOP), and the Standing Committee on Performance Management (SCOPM) since these Committees have the most direct relevance to asset management (and the Subcommittee on Asset Management reports to both SCOH and SCOP).

In addition to supporting strong asset management advocates on the committees, the TAM ETG recommends the following roles and responsibilities for the AASHTO Subcommittee on Asset Management:

- Share the future vision for asset management with key AASHTO Committees.
- Promote projects that support the implementation of the TAM ETG strategic plan recommendations.

- Develop a strategy for strengthening the support for TAM-related research among the Standing Committee on Research (SCOR) and the Research Advisory Committee (RAC).
- Over time, improve the awareness of the Standing Committee on Finance and Administration on long-term financial planning.
- Support the funding of research initiatives to further advance the development of guidelines, tools, and templates that enhance the state-of-the-practice in accordance with this plan and future efforts of the TAM ETG to develop a research roadmap.
- Work with FHWA and TRB to support capacity development activities including webinars, peer exchanges, and other forms of technology transfer.
- Support the on-going maintenance of a knowledge portal for asset management.

TRB

TRB is a division of the National Research Council that serves as an independent advisor to the Federal government and others on scientific and technical questions of national importance. The primary focus of TRB is to provide leadership and progress through research and information exchange. Therefore, TRB can support asset management at each of the three levels of implementation: awareness building, capacity building, and the development of guidance, tools, and templates. The primary recommendations for TRB roles and responsibilities are listed below:

- Support the development and funding of research needs statements that advance the recommendations contained in this document and align with the research roadmap that will be developed by the TAM ETG in the future.
- Support asset management outreach activities, including conferences, webconferences, and peer exchanges.
- Provide continued support for the Asset Management Committee (ABC40) and its role in communicating and sharing information with practitioners and researchers.
- Develop conference programs that continue to advance the practice of asset management among state transportation agencies.
- Collaborate with AASHTO and FHWA on outreach activities that further advance the recommendations contained in this document.

Transportation Asset Management Expert Task Group

This document summarizes the work of the TAM ETG to establish a strategic vision that will advance the maturity of asset management practices in state transportation agencies over time. This vision outlines focus areas that must be addressed to continue the evolution of asset management practices in the United States and the plan suggests activities that will build the workforce skills, agency capacity, and tools that are needed to address the changing needs. To support these efforts, the strategic plan includes a recommendation to continue the work of the TAM ETG to help ensure that the recommendations included in this document are implemented and to provide technical guidance to FHWA, AASHTO, and TRB as they address issues that arise during the implementation process. As a forward-focused group, the TAM ETG will continue to help drive the continued evolution of asset management practices in the United States.

The existing members of the TAM ETG strongly support the continuation of the group into the future to achieve the following objective:

To drive the implementation of this strategic vision for asset management and to ensure that sound, shared, and comprehensive guidance based on recent developments and best practices are being developed, implemented, and pursued by FHWA, AASHTO, and TRB in support of all States.

The future roles and responsibilities of the TAM ETG include the following:

- Advance the implementation of the recommendations included in this document in cooperation with FHWA, AASHTO, and TRB.
- Provide suggestions and technical guidance regarding implementation issues that arise as states pursue advanced levels of maturity in their asset management practices.
- Develop a research roadmap that is tied to the recommendations contained in this strategic plan regarding the development of guidance, tools, and templates for asset management.
- Provide feedback during the development of technical materials, guidelines, and relevant policies.
- Consider and provide input towards the development of strategies to address implementation gaps experienced by the States.
- Develop a communication strategy for advancing the maturity of asset management practices and the use of long-term financial planning.
- Identify current and future focus areas and contribute to the development of these areas.
- Provide a forum for information and knowledge sharing on national and international developments.
- Act as a link between FHWA, AASHTO, and TRB activities related to asset management.

The TAM ETG will be comprised of nine members who are recognized experts in the field of asset management. Membership may include representatives from State transportation agencies, local or regional transportation agencies, and/or academia. In addition, representatives from FHWA, AASHTO, and TRB will serve as liaisons to the TAM ETG. Representatives from private industry may attend meetings of the TAM ETG, but may not be members of the TAM ETG.

Conclusion

The TAM ETG was formed, in part, to identify strategies that advance asset management practices in state transportation agencies and to provide input to FHWA, AASHTO, and TRB regarding outreach efforts, capacity building activities, and applied research efforts that address current and future agency needs. The recommendations contained in this document present a strategic plan for advancing the maturity of asset management practices with time and define the roles and responsibilities of FHWA, AASHTO, and TRB in supporting the implementation of the plan. As spelled out in this document, the TAM ETG is expected to oversee the implementation of the strategic plan and to provide on-going guidance to FHWA, AASHTO, and

TRB as the needs of the states evolve with time. The collective efforts of these groups in support of the implementation of the strategic plan will advance the implementation of asset management far beyond the requirements specified in the MAP-21 legislation and will result in more financially-sustainable strategies for preserving asset performance and value over the long run.

References

American Association of State Highway and Transportation Officials (AASHTO). 2011. *Transportation Asset Management Guide – A Focus on Implementation*. AASHTO, Washington, DC.