## Commission Briefing Paper 4I-02

# The Role of Asset Management in the Surface Transportation System

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### Introduction

This paper is part of a series of briefing papers to be prepared for the National Surface Transportation Policy and Revenue Study Commission authorized in Section 1909 of SAFETEA-LU. The papers are intended to synthesize the state-of-the-practice consensus on the issues that are relevant to the Commission's charge outlined in Section 1909, and will serve as background material in developing the analyses to be presented in the final report of the Commission.

This paper presents information on asset management. It defines asset management, notes its benefits and role in surface transportation, discusses the state of the practice in the United States and abroad, and presents federal policy options for applying asset management principles and practices.

### Background and Key Findings

Over the past five years asset management concepts have taken hold through the efforts of the Federal Highway Administration (FHWA) working with the American Association of State Highway and Transportation Officials (AASHTO), the Transportation Research Board (TRB), and other partners. The core principles of asset management are now widely accepted throughout the transportation community (although application of these principles to business practices has often lagged). These principles hold that asset management is:

- **Policy-Driven –** Resource allocation decisions are based on a well-defined and explicitly stated set of policy goals and objectives.
- **Performance-Based –** Policy objectives are translated into system performance measures that are used for strategic management and tied to the resource allocation process.
- **Analysis of Options and Tradeoffs –** Decisions on how to allocate resources within and across different types of investments are based on an analysis of how different allocations will impact the achievement of relevant policy objectives.
- **Decisions Based on Quality Information –** The merits of different options with respect to an agency's policy goals are evaluated using credible and current data. Where appropriate, decision support tools are used to provide easy access to needed information, to assist with performance tracking and predictions, and to perform specialized analysis.
- **Monitoring to Provide Clear Accountability and Feedback –** Performance results are monitored and reported. Feedback on actual performance may influence agency goals and objectives, as well as resource allocation and investment decisions in future budget cycles.

Key findings of this paper include:

- The application of asset management principles and practices offers great potential for preserving and improving surface transportation infrastructure conditions in more efficient and cost-effective ways.
- The benefits of asset management include extending the useful life of physical assets, minimizing the life-cycle costs of capital investments and ongoing maintenance and operations, and maximizing benefits while minimizing inconveniences to surface transportation customers.
- The awareness of asset management concepts and tools and their application by public sector surface transportation owners—particularly State DOTs—has grown substantially in the past decade as a result of AASHTO and US DOT initiatives.
- Virtually all State DOTs have implemented systems for inventorying, assessing condition, and monitoring the performance of major asset categories such as bridges and pavements, and many use this information to guide priority setting as well as levels and distribution of investments. Many states are assessing other asset categories and incorporating this information into their decision-making process.
- However, on a national basis few State DOTs and other public sector owners of surface transportation infrastructure are implementing asset management principles and practices to the fullest potential.
- Information from asset management tools and data is rarely linked to public-sector resource allocation decision-making at the highest levels in a comprehensive framework that explores policy options, examines the consequences of alternative investment strategies, influences tradeoffs among these strategies, targets performance, and monitors outcomes.
- A major policy question for the United States is whether the federal government should consider a more proactive leadership role in advancing asset management principles and practices with respect to this country's most critically important surface transportation assets—particularly those elements of the interstate, freight rail, and passenger rail systems whose functionality is vital to the economy and security of the nation as a whole.

## Role of Asset Management in Planning, Operating, Maintaining, Upgrading, and Expanding the Surface Transportation System

### Scope of Activities

Asset management as practiced in the United States is anything but a "one size fits all" process. In fact, one of the key decisions an organization must make is the scope of activities and assets that will be covered under an asset management umbrella.

The narrowest view of asset management will typically limit the scope to the preservation of existing infrastructure assets. Agencies with a broader application of asset management will include consideration of how well the system operates, whether capacity expansion is cost beneficial, what the modal options might be, and how safety initiatives will fare against other high priorities. These agencies will adopt asset management to analyze investment tradeoffs among different types of improvements (e.g., preservation versus expansion) or different types of assets (e.g., pavement versus structures).

Organizations with a yet broader view of asset management will view it as an enterprise-wide activity. This may include human resource options and strategies, with employees viewed as valuable assets to be considered in the mix of investment opportunities and tradeoffs.

## Allocation of Responsibility

Asset management is a responsibility of the infrastructure owner. Because the vast majority of transportation assets are owned by entities other than the federal government, federal involvement has consisted of research, development, technical support, training, promotion, and sharing lessons learned. State and local governments, transit agencies, and (increasingly) private institutions assume management, maintenance, and operating responsibility over the long life of surface transportation capital investments.

While US DOT encourages asset management, it does not outline a specific process or require specific practices. Clearly, in the majority of situations, the approach must be tailored to the specific circumstances of the managing entity, the institutional context, the assets being managed, and the underlying expectations of the owner.

## Components of Asset Management

Data and performance measurement are required for any asset management strategy. With an inventory of all system assets and information on the condition and performance of each asset against a template of performance thresholds and targets, agencies can systematically and objectively identify opportunities for investment. Software tools calibrated to historic data can be used to predict future asset conditions, allowing the agency to analyze the potential costs and benefits of making improvements now versus deferring them until later. Rather than merely measuring and evaluating asset conditions in absolute terms, agencies subscribing to asset management will measure how well they are achieving their objectives, i.e., measure success, and measure the useful remaining life of assets.

With this information, agencies can develop strategies and programs for preserving their existing assets in a manner that fits their unique requirements. "Preservation" describes proactive measures that reduce the rate of deterioration (as a result of weather, traffic, and other factors) and extend an asset's life, such as repaving a highway or repairing a bridge. Engineers and economists think of it as an intervention in the flat section of a deterioration curve. The deterioration curve demonstrates the consequences of declining conditions and escalating costs if preservation actions are deferred.

In addition to focusing on preservation, asset management emphasizes looking at "life-cycle" costs and not just lowest initial costs. Life-cycle analysis may examine all costs—those incurred by the agency as well as by the transportation system users—over the complete life of an investment. Preservation strategies reduce life-cycle costs, but so can other measures that may involve new construction using higher quality materials or more durable structural elements that have a higher initial cost but less frequent and less costly maintenance and repairs. Including user costs, such as the value of travelers' or shippers' time lost due to construction or maintenance related delays can have a profound impact on the results of a life-cycle economic analysis, typically justifying the greater investment in a more durable and resilient initial design. Asset management facilitates the ability of agencies to reduce their emphasis on providing

projects at the lowest initial costs, and instead, deliver the best value to their customers over the long run. This approach requires a longer-term strategic focus than traditionally used in infrastructure management and decision-making, which tends to react to funding shortfalls and political pressures.

Asset management also includes improving or maintaining asset conditions at appropriate target levels. For example, Ohio DOT's asset management program helped the agency reduce pavement deficiencies by almost 70 percent, with 96 percent of road miles meeting the agency's pavement goals after the program was implemented.

In order to practice asset management, agencies must link data from field assessments and information derived from software tools to actual resource allocation. Without this linkage, the data is of limited value. This linkage is not a technical element. It must happen within the working dynamic of the agency—transforming data collected in the field into information that can be used by decision-makers as they wrestle with the choices and tradeoffs they must make.

To influence the decision-making process, asset management tools are often used to create "what if" scenarios to ensure that a reasonable array of options is considered. Agencies can examine a range of investment alternatives and communicate to decisonmakers the needs and consequences of investing (or failing to invest) in specific types of assets.

Finally, asset management is ingrained with a culture of accountability—taking responsibility for an objective, performance-driven, business-like approach that is rooted in factual information and driven by the desire to achieve the greatest value for the taxpayer's money.

## State of the Practice in State DOTs

Despite the benefits of asset management, few state departments of transportation practice it as described in the previous section. All state DOTs have inventory information for the major infrastructure categories and monitor conditions periodically, using bridge and pavement management systems. Increasingly state transportation agencies employ systems to monitor safety and traffic congestion. Some agencies employ predictive tools to predict future performance and to evaluate the costs and benefits of alternative preservation and investment strategies. And while virtually all employ methodologies to analyze the data, to develop findings, reach conclusions and formulate recommendations, it is not uncommon for much of this work to remain within individual technically focused domains of the agency. The inclination and the ability to view and apply this information holistically, across asset categories and across functional and organizational boundaries, to formulate and assess strategic options comprehensively among these categories, and to interact with the highest level decision-makers in order to drive decision-making in a more systemic and objective manner varies greatly among transportation agencies with a relative few operating near the full potential defined by state of the art tools and technologies.

Resource allocation decisions are still primarily based on array of subjective policy level or project driven and political pressures, and it would be naïve to believe that these real-world factors will completely disappear in favor of strictly data-driven, merit-based, optimizations.

## Alternative Approaches

Applying asset management principles and practices to the process of influencing the amount and allocation of resources for surface transportation investment reflects a clear choice of this option from among several fundamentally different approaches (described below)—all of which are commonly used with varying degrees of effectiveness. Most knowledgeable observers would agree that an asset management approach offers the greatest potential for "getting it right" in terms of optimizing economic return on investment and fulfilling critical operational and engineering requirements. But most would also agree that under the best of circumstances, other factors—such as political pressures and equity criteria—provide the kind of reality check necessary to sustain the credibility of the process and its participants. The various approaches might be characterized as:

1) Extrapolating Trends
2) Politically Driven/Subjective Judgments
3) Strategically Driven/Subjective Judgments
4) Strategically Driven/Objective Judgments (Asset Management)

**Extrapolating Trends** is predicated upon the notion that future investment requirements can be developed on the basis of past and current experience. It is an approach that has worked surprisingly well among many agencies for many years—particularly during periods of relative stability in the mission of an agency and the policies and programs it must sustain to fulfill that mission. However it is an inherently flawed approach for obvious reasons in an era characterized by missions, policies, and programs that are often in a state of change, responding to shifting expectations and mandates—which explains its declining value and use.

**Politically Driven/Subjective Judgments** represents an approach in widespread use among all levels of government – from the Congressional earmarks that consume an increasing share of formula or merit-based federal funds to the political "tugs-of-war" at the state and local level in which the number of votes or the political power of key decision-makers are often the dominant factors in determining the size of the transportation resource pie and how it is shared. It is an approach that can lead to spending less where the need may be greatest and more where the need may be least.

**Strategically Driven/Subjective Judgment** is a widely used approach where a strong desire exists to "get it right" on the merits, but where there is either little objective information available or there is a disconnect between the technically-focused stewards of data acquisition and the strategically-focused stewards of policy making—a not uncommon occurrence. This approach can be quite effective even in the absence of a systematic framework of information and analysis if it is characterized by a strategic process that considers and encourages insightful scrutiny and debate among knowledgeable key stakeholders—customers and providers—as to alternative outcomes, policies, strategies and implementing programs. In this approach, experience and intuition dominate the contextual framework for decision-making

**Strategically Driven/Objective Judgments** – In this approach, information and analysis provide an important context within which options can be defined, tradeoffs can be considered, risks and consequences can be understood, conclusions can be reached and decisions can be

made. This is the approach epitomized by asset management. And while it draws heavily on information and analysis relating to the condition of existing assets and the resources required to achieve a range of alternative outcomes, asset management is decidedly not a "black box" decision tool. The asset management approach relies ultimately on judgment, and while these judgments can be strongly influenced by information and analysis, they are most often filtered through a prism of experience and intuition. As political factors, along with other influences subjective by their nature, inevitably enter the picture they can be sifted and weighed in a crucible of more objective information and analyses. While ultimately there is no substitute for judgment, asset management provides the ability to reach decisions with an acute awareness of consequences and opportunity costs. Several transportation agencies have embraced this approach and realized significant benefits. For example, new transportation revenue programs were adopted by the legislatures in Washington, Ohio, and Maryland, in part due to these transportation agencies' data-driven demonstration of stewardship and need.

## Role of Asset Management in Australia, New Zealand and the United Kingdom

Asset management is practiced extensively in New Zealand. Decision-making relies on several tiers of planning activities, which link objectives to performance measurement and results. Multi-year plans commonly identify proposed investment activities and specify how those investments will meet performance targets.

Annual plans for individual roadways are also developed. These plans note current conditions, past performance, and historic trends; suggest future strategies; make funding requests; and provide justification for the requested investment. Performance targets are linked to road type, usually by the number of vehicles that use the facility. If the national budget for a particular asset category is cut, the performance targets are revisited.

Maintenance activities on the national road network are privatized and two-thirds of the national transportation agency's 5- to 10-year contracts are performance-based. Where the private sector assumes both capital and operating costs, it has economic incentives to make investments and choices that result in the lowest life-cycle cost. As a result, the private sector is encouraged to maintain good asset conditions.

Asset management practices are similar in Australia, but the federal government plays a much smaller role than in New Zealand. Most major transportation decisions are left to Australian states and territories, and they are heavily influenced by the life-cycle cost of investment options. Australia's relatively large number of public-private partnerships and private sector road maintenance contracts also promote performance measurement and linking performance to investment decisions.

Industry associations in Australia and New Zealand have contributed to asset management with leadership, research, and publications. For example, the National Asset Management Steering (NAMS) Group has created an *International Infrastructure Management* manual, which is an industry standard.

In England, the Highways Agency (HA) is the owner of the national motorway network and major trunk roads. Asset management helps HA meet its objectives of giving priority to

maintenance and delivering a targeted program of improvements to the network. Work is focused on maintaining motorways and trunk roads on a minimum whole life cost basis, protecting the value of these assets, ensuring the network is safe and reliable, contributing to a better environment, and providing value for money when delivering improvements.

Initially operations and maintenance for the national network was performed by local government (County Councils) with funding provided by HA, but beginning in 1997 HA contracted out this function to the private sector. The country has been divided into approximately 20 areas with a private contractor responsible for each under the terms of a performance-specified maintenance contract. Effective administration of these contracts requires HA to carefully define and measure its performance targets.

In all three countries, the credibility of the transportation agency and its methodologies in the political realm has been essential. Ultimately, policies and budgets proposed by these agencies are subject to actions of a legislative body. With an objective and credible asset management framework, and effective communication of complex information in a comprehensive and a comprehensible context, the chances for buy-in among elected officials are greatly enhanced. The alternatives—offering strategy and spending proposals predicated on trend-based or subjective and seemingly arbitrary factors, invite elected officials to substitute their own judgments on the basis that their intuitive decisions are as valid as the agency's.

## Federal Role in Surface Transportation Asset Management

During the past 50 years, the federal role in surface transportation has focused on system expansion. Since the completion of the Interstate System, however, the preponderance of capital improvements being made by State and local governments using Federal and other funding resources has been shifting to reconstruction, rehabilitation, and resurfacing of existing infrastructure (reaching 52.6 percent of capital expenditures for highways and bridges in 2002). This shift reflects the reality that the overall performance of the transportation system—whether in terms of capacity, safety, quality, or cost—is influenced much more by the overwhelming proportion of the system that represents existing infrastructure as opposed to new facilities which will affect performance at the margin.

It is clear that the federal government has an interest in protecting and making the most of the nation's $2.51 trillion investment in public transportation fixed assets. These systems play pivotal roles in serving key national objectives, including interstate commerce and national security. What isn't clear, particularly since the ownership and operational management of these assets is not a federal role (except for infrastructure on federally-owned lands), is how far the federal government should go to ensure that they are in sufficiently good condition to meet requirements that are essential to the nation as a whole.

Failure to adequately manage assets of critical national importance could jeopardize the economy, national security, and quality of life that we have come to enjoy. These assets typically connect metropolitan areas, where 80 percent of our nation lives and 85 percent of our economic output occurs. Metropolitan areas are the competitive units in the global economy, and our transportation system is a comparative advantage for the United States. As other countries try to replicate the success of our system, the U. S. needs to retain this advantage with

well-targeted investments and appropriate performance standards. Assets of critical national importance might include select portions of the Interstate Highway System (IHS) and the National Highway System (NHS), critical connectors, and the most important passenger and freight rail corridors.

Specific examples of surface transportation facilities critically important to the country would include long distance Interstate highways such as I-95, the Northeast Corridor Amtrak passenger rail service, and the Los Angeles to Chicago freight rail infrastructure. Interstate 95 serves the nation's capital, financial centers, and a number of large ports along the eastern seaboard. Although users view it as a single corridor, and many assume that Interstate highways are under the custody of the federal government, this asset is managed in varying ways by its many different transportation agency owners including 14 state DOTs, eight toll agencies, and one municipality. Furthermore, consideration by at least one state to lease an existing toll road that includes I-95 would bring in private sector managers as well.

As a small example of how fragmentation in asset management practices can affect operations along a single corridor of critical national significance, consider how electronic toll collection is handled on the sections of I-95 that are toll roads. After years of deploying varying systems, all of the toll roads along I-95 in the Northeast now offer E-ZPass. Nevertheless, the signing, lane configuration, and availability of electronic toll collection are handled differently by each toll authority, creating confusion and potentially a safety issue. In the realm of system preservation, examples abound along I-95 and virtually all other Interstate corridors where the condition of pavements and bridges may vary significantly as a result of different condition performance targets and funding priorities.

Northeast Corridor passenger rail is similar in national importance to I-95, and in a sense is part of a common intermodal corridor that also serves the nation's capital and several of our largest metropolitan areas. This asset, which is managed by a quasi-public entity, is becoming increasingly important to our economy as oil prices rise and security issues strain the commercial air travel system. However, despite its national significance, this passenger rail service has suffered from years of under-funding, resulting in deferred maintenance and generally insufficient preservation activities. The impact has been frequent passenger delays and more expensive life-cycle costs.

Another example of rail infrastructure of critical national significance is the freight corridor between Chicago and Los Angeles providing the most heavily used long-distance freight rail service in the country. It links our two largest container ports with the nation's largest rail hub, and plays a critical role in global movement of cargo. For example, it clearly surpasses all other North American rail routes in the number of automobile and intermodal container shipments. However, little or no federal involvement in the management of this asset has been considered since it is a private sector responsibility. Is there sufficient national interest in this freight rail corridor to justify a larger federal role in how this critically important asset is managed?

The founding fathers recognized the inherent national interest in interstate commerce, and implicitly, how unlikely it was that the individual actions among a collection of sovereign states could be counted upon to serve the best interests of the nation as a whole. Federal legislation

and regulation, predicated upon the Interstate Commerce clause, have fostered the development and regulation of inland waterways from the Atlantic Ocean to the Ohio Valley and from the Great Lakes to the Mississippi, continental railroads from coast to coast and border to border, and a vast network of interstate and other highways of national significance that crisscross the land like the web of a spider. With varying roles for the states, localities, and the private sector, the federal contribution in all of these great achievements was one of providing essential leadership and, certainly in the case of roads, financial support.

Now, with such systems in varying degrees of maturity and the Interstate System completed, the federal role has clearly changed. Instead of leading the way toward achieving well-defined outcomes on a national scale and driven by national interests, the federal role has become one best characterized as 'encouraging' rather than 'requiring,' 'facilitating' rather than 'mandating,' 'evaluating' rather than 'initiating,' 'auditing' rather than 'formulating.' Many celebrate this evolution of the federal role as more appropriate to our federal system and better suited to an era focused more upon managing existing as opposed to deploying new assets. Nevertheless, in examining the concept of asset management and how it might be best employed on a national scale, the question should as a minimum be raised and addressed as to whether it is appropriate for the federal role to be relatively confined, as it has been, or whether there are some assets whose importance to the nation's commerce, security, and quality of life are of such a critical nature that a larger role is appropriate.

Central to the question of the appropriate federal role in asset management is the question of just what is it that might constitute a sufficient national interest to support participation by the federal government in more of a proactive and less of an observer role. The following is offered for consideration to stimulate a discussion and debate:

*"Transportation corridors and facilities of critical national interest" are defined as those which if removed or impaired in their ability to serve their intended functions would likely result in dire consequences to the nation as a whole, and whose immediate restoration and long-term serviceability would be widely recognized as being of the utmost national importance.*

The simple question is whether a greater federal role in the management of these kinds of assets may be justified? Is there a correlation that should be drawn between an appropriate level of federal asset management involvement and the type of asset as reflected by national importance? How should critically important privately owned assets be handled? Exhibit 1 presents a simple depiction of federal policy options for the management of surface transportation assets. The intention here is not to make a recommendation, but rather to spark the discussion and debate that is needed to arrive at a conclusion based upon informed judgment and not upon institutional inertia.

**Exhibit 1: Options for Federal Interest in Surface Transportation Asset Management**

| Type of Asset | Federal Policy Options for Management of Assets | | | |
|---|---|---|---|---|
| | Neutral | Encouraged | Incentivized | Mandated |
| Asset of Critical National Importance | | | ✓ | ✓ |
| Asset of General National Importance | | ✓ | ✓ | |
| Assets of State and Local Importance | ✓ | ✓ | | |
| Federally Owned Assets | | | | ✓ |

Because of their unique importance, the federal government might consider the possibility of legislatively requiring an asset management framework for publicly owned assets of critical national importance (particularly where federal funds have already been invested) and the possibility of incentivizing a similar outcome for private sector assets. A mandate would require asset owners to at least coordinate, if not integrate, an asset management process for assets that cross state borders. The federal government might specify asset investment requirements based on information for acceptable performance targets on a national scale. In return, states with assets of critical national importance might be given additional federal funding and more attractive funding match requirements.

Incentives, such as a percentage increase in federal-aid allocations, might also be offered to state agencies with qualified asset management programs. These could be offered for both assets of critical national importance and assets of general national importance. The latter might include the remainder of the IHS, all NHS routes, some freight rail corridors, and important intercity passenger rail and transit network assets.

Another policy option is simply to continue to encourage asset management. "Encouragement" is essentially US DOT's current role in asset management, which includes research, training, and support for tool development. The "encouragement" option might be appropriate for assets of state and local importance.

Finally, asset management could be required for federally owned assets such as Federal Lands Highways. Most of these roads serve national parks, national forests and other federal jurisdiction lands. While they may not necessarily be individually critical to the nation's economy, they are significant collectively. Federal Lands Highways has already undertaken important steps to implement asset management principles and tools.

There are many policy choices and tradeoffs to be considered. What better approach to address these issues than to apply the very principles of asset management to help determine the federal role in surface transportation asset management, relying upon objectively driven information, analyses, performance goals, tradeoffs, informed decision-making, and monitoring outcomes to determine if goals are being met and the national interest is being served.

**CONSOLIDATED COMMENTS FROM MEMBERS OF THE BLUE RIBBON PANEL OF TRANSPORTATION EXPERTS - PAPER 4I-02**

One reviewer commented as follows:

Asset management for achieving strategic outcomes is just emerging as an engineering/economic process. The paper sets the stage – but it does not discuss one of its most important aspects: decision-making processes. Further exploration of this element would be valuable. consideration.

Another reviewer commented as follows:

On page 2 the paper states: "A major policy question for the United States is whether the federal government should consider a more proactive leadership role in advancing asset management principles and practices with respect to this country's most critically important surface transportation assets — particularly those elements of the interstate, freight rail, and passenger rail systems whose functionality is vital to the economy and security of the nation as a whole." This reviewer would suggest that the situation might be different for publicly-owned assets and systems (*e.g.*, interstate, passenger rail), but there is no reason why private sector U.S. freight railroads, which are the most cost effective and efficient in the world, need the government to provide a "proactive leadership role" regarding how freight rail assets are managed.

Another reviewer commented as follows:

The paper first summarizes expected role of asset management in planning, operation, maintenance, upgrading, and expansion of the surface transportation system. Ideal functions of asset management are discussed in terms of scope of activities, allocation of responsibility, and management components. At present State DOTs in the U.S. are not using asset management at the desired level. While there is much activity in data acquisition, inventory, and analysis, the strategic application of obtained information through interaction with the highest level decision-makers, is missing. The paper suggests a Federal role in surface transportation asset management, as the Federal government has distinctively provided for assets with different levels of national importance.

The paper reviews asset management practices in other countries—Australia, New Zealand, and United Kingdom. However, it is not clear what lessons can be learned from them, especially given that there are differences in governmental structure and highway ownership across the countries. More analytical comparison between practices in other countries and those in the U.S. could be conducted. For example, discussions on factors found to be keys to success or failure in other countries could be useful.

While the paper addresses the issue of strategic role of asset management, it does not probe deeply into the topic. More needs to be done to define strategic decision-making using asset management procedures.