

HIGHWAY ASSET MANAGEMENT

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ABSTRACT

Maintaining the infrastructure of roads, highways, and bridges is paramount to ensuring that these assets will remain safe and reliable in the future. If maintenance costs remain the same or continue to escalate, and additional funding is not made available, the highway agency may need to reduce new construction or cut back on maintenance, or both. There is a close relationship between the cost of optimally scheduled preventive maintenance versus the cost of emergency maintenance or replacement. The study develops a systemic risk-based asset management methodology to manage the maintenance of highway infrastructure systems. The decision making methodology is used to harmonize and coordinate the actions of the different units and levels in a hierarchical organization. The systemic methodology enables the filtering and assessment of assets for maintenance while addressing the potential for extreme events. The methodology balances the costs, benefits, and risks of maintenance and inspection policies as applied to various types of assets. Three objective functions are used in evaluating options and strategies: minimizing short-term cost, minimizing long-term cost, and maximizing the remaining service life of highway assets. A constraint function harmonizes the remaining service life across assets to eliminate infeasible options. The methodology is generally applicable to the asset management of large-scale dynamic systems that exhibit characteristics similar to those of highway systems.

INTRODUCTION

In recent years, there has been increasing attention given to Asset Management. Like the latest diet fad, major claims have begun circulating about the wonders of this “new” approach to infrastructure management.¹ Indeed, the promotional hype is reminiscent of past management schemes, such as zero-based-budgeting (ZBB), management-by-objectives (MBO), total quality management (TQM), and business process reengineering (BPR). Is Asset Management merely the latest in a long line of management fads being marketed by consultants to transportation agency managers – or is it an effective remedy to address the fiscal challenges confronting our nation’s highway infrastructure? This paper explores these issues in light of recent developments in the funding, condition, documentation, and management of our nation’s highway infrastructure. The paper suggests:

- Public sources of funding for the nation’s highway system will not be adequate to renovate or replace current highways, and build new capacity.

- Closing the expected shortfall in public highway funding will require sustained infusions of private sector funding.
- Financing of highways through public-private partnerships will require state and local transportation agencies to radically change the ways in which highway infrastructure is managed.
- Asset management has a critical role to play in demonstrating prudent stewardship of highway infrastructure and facilitating private sector confidence in highway investments.
- According to AASHTO, “Transportation Asset Management is a strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their life-cycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based on quality information and well-defined objectives.” In the transportation field, AM involves a large array of system components. Examples of these assets include “pavements, pavement

markings, raised pavement markers, structures, roadside signs, traffic signals, roadway illumination, traffic barriers, guard fences, attenuators, maintenance equipment, vehicles, intelligent transportation system (ITS) equipment, traffic detection equipment, real estate, corporate data and materials” (Kuhn 2011). The items under state DOT jurisdiction vary, but most often include a large amount of linear transportation assets.

ASSET MANAGEMENT HISTORY

Even though AM science and practice is not new—agencies in Europe, New Zealand and Australia, and Canada started in the late 1980s and early 1990s—transportation agencies in the United States were focusing on the management of pavements and bridges as individual assets rather than on a comprehensive, integrated, and long-term approach to man-aging all assets under their jurisdiction.

In 1996, AASHTO and FHWA hosted an executive-level AM seminar in Washington, D.C., to introduce AM to the state transportation agencies. During this event, participants drawn from the leadership of AASHTO, FHWA, state transportation departments, private industry, utility companies, quasi-government organizations, and research and supplier communities shared experience and expertise to improve the quality of AM. The results are documented in FHWA’s Asset Management: Advancing the State of the Art into the 21st Century Through Public-Private Dialogue (1997), which describes the goals, attributes, and usefulness of AM. The seminar focused on the need for integrated decision making and the idea of going beyond just pavements and bridges.

The executive seminar in the District of Columbia was followed by another executive workshop hosted by AASHTO and FHWA in October 1997 in Troy, New York. The mission of the workshop was to evaluate current AM practices, technologies, and tools, and to develop a strategy for moving forward a cooperative AM initiative. A basic definition of AM was introduced during the meeting and later adopted by AASHTO. These two events were the

beginning of the ongoing biennial series of National Asset Management Conferences. The most recent conference (9th National Asset Management Conference) in San Diego attracted more than 320 attendees with 34 state DOTs represented.

BACKGROUND

Since its inception in the mid 1950s, the Eisenhower System of Interstate and Defense Highways has vastly exceeded the expectations of its creators, in terms of enhanced mobility, population decentralization, and economic stimulus nationwide. However, a number of flaws in our nation’s highway program produced certain unintended consequences. Disregard for the environmental and community impacts of massive highway development led to the disruption of many environmentally sensitive areas and urban neighborhoods, particularly in less affluent communities. The absence of Federal funding for highway maintenance created an inherent bias towards capital projects, with state and local transportation agencies limiting maintenance efforts to conserve local resources. In addition, a lack of accountability for highway infrastructure management and preservation resulted in state and local decision-makers perceiving highway infrastructure as merely a “sunk cost”.

A major challenge for highway officials is finding adequate funding to rehabilitate the nation’s highway system, add new lanes, and provide for new highways. Despite the past decade’s growth in public funding of highways, available public resources are not expected to be adequate to fully address these needs. Given the persistence of these issues and the potential consequences for our nation’s economic well being, this paper explores three related hypotheses:

- (1) Private sector financial resources are needed to leverage available public funding to rehabilitate and create needed highway infrastructure.
- (2) Public sector transportation agencies will be required to demonstrate prudent stewardship of their highway assets over the long-term

before the private sector commits funding for highway infrastructure.

- (3) Asset management provides public agencies with proven ways to demonstrate prudent stewardship of infrastructure assets, when applied throughout the highway development and preservation life cycle.

Asset Classification Incorporating Potential for Extreme Events

The highway assets that compete for maintenance funding are varied and numerous. With limited available funding, it is necessary to develop an effective classification scheme that Identification of Risk Sources, Opportunities, and Effects Asset Classification Asset Level Tradeoff Aggregation of Lower-level Options 6 enables decision makers to determine the priority and urgency level of each asset. The classification process filters the number of assets in need of maintenance down to a more manageable level so that the most critical can receive appropriate attention and tradeoff analysis can be performed. The vulnerability of the highway agencies maintenance activities to extreme events is studied by identifying risk scenarios that affect an assets ability to meet performance or service-level criteria. The potential impacts of extreme events on the asset help guide the asset classification process. For the purpose of maintenance, a highway asset may be classified as must, non-must, or reconstruction. Figure 3 shows the asset classification flow. An assets condition may be allowed to deteriorate if it is scheduled for rehabilitation or replacement. Such an asset is classified as a reconstruction in the agencies construction or improvement plan, and it is removed from further consideration in the maintenance division. If an asset is not a reconstruction, then its maintenance priority or urgency level is identified. The explicit identification of high-priority maintenance assets (must) vs. lower-priority assets (non-must) is based upon the systemic consideration of maintenance risks. Must assets are in critical condition or are critical to the operation of the highway system. Assets that undergo preventive maintenance actions are also considered musts

because such actions prevent further deterioration

Innovative Financing Methods and Management Systems

During the 1980s, as highway infrastructure needs began to outpace traditional funding sources, state and local governments began to experiment with alternative ways to finance highway projects. Besides increasing user fees and taxes, this included:

- Establishing special assessment taxing districts
 - Dedicating sales tax increments
 - Entering into design-build-finance contracts.
- Starting with the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), and continuing with the passage of the National Highway System Designation Act of 1995, the Transportation Infrastructure Finance and Innovation Act of 1998 (TIFIA), and the Transportation Equity Act for the Twenty-First Century of 1998 (TEA-21), Congress has expanded the options available to state and local governments to finance highway infrastructure projects These include:
- Reaffirming the viability of toll-based financing of highway infrastructure
 - Capitalizing State Infrastructure Banks (SIB) in a number of states to augment traditional funding programs by:
 - Providing a range of loans and credit enhancement products
 - Providing a pooling mechanism for private and public funding involving all levels of government
 - Establishing a Federal credit program for projects of national significance that include secured loans, loan guarantees, and lines of credit
 - Encouraging private-public partnerships
 - Enabling state and local governments to bond against future Federal funding allocations through Grant Anticipation Notes (GANs) and Grant Anticipation Revenue Vehicle bonds (GARVEE bonds)
 - Expanding design-build-finance contract concepts to design-build-operate-maintain-finance.

Other innovative financing approaches that have recently evolved include:

- Long-term maintenance warranties (New Mexico)

Privatization of asset management (Colorado E-470), maintenance and operations (selected Interstate highways)

PREREQUISITES FOR ADDRESSING UNFUNDED HIGHWAY NEEDS

The economic boom of the 1990s produced record levels of employment and travel nationwide, which resulted in growing levels of highway congestion. Serving the public's burgeoning demand for mobility while relieving congestion will require a holistic, multi-dimensional approach to transportation asset management, including a diverse set of transportation options (including all modes of transportation, such as public transportation, highways, bike/walking trails, etc.) and encompassing both supply-side management techniques (such as additional or expanded transportation facilities, services, and capabilities) and demand-side management techniques (such as ridesharing, telecommuting, mixed-use development, alternative/flexible work schedules, etc.).

While demand-side management approaches have the potential to moderate the public's travel requirements, particularly in the peak commuting hours, it is expected that Americans will continue their love affair with the automobile, resulting in ever increasing demands for highway capacity and automobile-based convenience. In some parts of the nation, open space limitations will curtail this appetite, leading to the implementation of more efficient transportation alternatives to the single-occupant automobile. However, in many growing areas of the nation with available open space to develop, public demands for increased mobility will require widening current highways, as well as building new highways. This will further increase the need for highway infrastructure funding, even as other forms of transportation and demand-side management approaches are explored.

The dilemma for highway officials is to find a way to increase the financial resources devoted to highway infrastructure without solely relying on traditional funding sources, such as the gas tax, which is becoming less robust due to improvements in auto fuel efficiency and the development of alternative fuels. The following pages discuss the three hypotheses noted earlier as a way to address this dilemma.

Shadow Tolling as a Mechanism to Ensure Repayment of Private Borrowing

An innovative highway financing technique used in Europe may have applicability here in the United States in connection with highway securitization: *shadow tolls*. Shadow tolls have been used successfully in Britain, Portugal, and Finland to finance highway capital improvements and related operating and maintenance costs using private sector vendors.

Under shadow tolling, a private consortium enters into a concession agreement with a governmental entity under which the private sector group finances certain improvements to a road and agrees to maintain it at a pre-defined service level for a certain time period (e.g. 20 years). The governmental unit (which could be national, state, or local) agrees to make annual payments to the firm based on the level of traffic utilizing the roadway, drawing on either transportation-related or general revenues.

State Infrastructure Banks as a Vehicle for Securitizing Highway Assets

State Infrastructure Banks (SIBs) could be used to coordinate and consolidate highway securitization efforts among public agencies and authorities in states where SIBs exist. Participants may include the state department of transportation, metropolitan planning organizations, council of governments, cities, counties, townships, and authorities. Instead of each jurisdiction securitizing its own highway assets, SIBs could serve as a financial intermediary to pool highway assets and coordinate with bond underwriting companies to achieve the lowest statewide financing and administration costs. Proceeds from the resulting

bond sales could be allocated to each participating jurisdiction based on the amount and quality of the revenue stream pledged to secure their loan.

A single bond offering involving multiple jurisdictions would represent a more efficient way to process the bond offering, thereby reducing overhead and administrative costs. Each participating jurisdiction would then be obligated to abide by the covenants of the highway securitization bonds. In the case of covenants relating to asset management, GASB 34's infrastructure reporting requirements would serve to reinforce compliance with these covenants

CONCLUSIONS

Currently trillions of dollars in public infrastructure are not reflected in the financial statements of state and local governments. As a result, these assets are considered sunk costs whose only financial significance is the drain they represent on the maintenance budgets of state and local infrastructure agencies. Traditional highway funding arrangements have favored capital expenditures for new construction by leaving maintenance funding responsibilities to state and local governments. The availability of relatively cheaper capital funds from the Federal government has inadvertently encouraged state and local governments to defer maintenance on their highway systems over the past forty years. This has produced higher life-cycle costs for highway infrastructure when compared to proper asset preservation.

Highway assets should be viewed as tangible assets whose inherent value can be used to stimulate further economic activity, instead of only sunk costs. Asset management provides state and local governments the opportunity to demonstrate stewardship of their highway infrastructure. Asset management also provides an impetus for establishing innovative methods for financing highway development, preservation, and documentation.

References

- McNeil, S; Tischer, ML; DeBlasio, AJ. *Asset Management: What is the Fuss?* Transportation Research Record 1729, Transportation

- Management and Education. Transportation Research Board. 2000.
- *Highway Funding 1997 – 2000*. U. S. Department of Transportation, Federal Highway Administration Bulletin, March 3, 2000.
- Grigg, Neil S. *Infrastructure Engineering and Management*. Wiley & Sons, New York, NY. 1988.
- Irick, PE; Carey, WN; Hain, RC. *A Rationale for Analysis of Pavement Performance*. Highway Research Board Special Reports, 1961.
- Clash, Thomas W., and John B Delaney. *New York State's Approach to Asset Management: A Case Study*. Transportation Research Record 1729, 2000. pp. 35-41.
- *Condition and Performance – 1999 Status of the Nation's Surface Transportation System. Report to Congress*. U.S. Department of Transportation, 2000, p. 6-6.
- Ibid. p. 6-15.
- Ibid. p. 6-5.
- Ibid. p. 8-8 and 8-9
- Gramlich, E.M. *Infrastructure Investment: A Review Essay*. Journal of Economic Literature, Volume 32. 1994. pp. 1176-96.
- Morrison, Catherine, and Ellen Schwartz. *State Infrastructure and Productive Performance*. The American Economic Review. December 1996. pp. 1095-1111.
- Highway Statistics 1999. U.S. Department of Transportation, Federal Highway Administration. Washington, D.C., November 1, 2000, Table HF-10B.
- *1998 Toll Industry Statistics*. International Bridge, Tunnel & Turnpike Association, Washington, D. C., 1998, pp. 65-67.
- *GASB Statement No. 34 – Basic Financial Statements – and Management's Discussion and Analysis – for State and Local Governments*. Governmental Accounting Standards Board. Norwalk, CT., June 1999.
- Peters, Tom. *Thriving on Chaos*. HarperCollins Publishers, 10 East 53rd Street, New York, NY 10022, 1987. p. 593.
- Pallot, June. *Infrastructure Accounting for Local Authorities: Technical Management and Political Context*. Financial Accounting and Management, Volume 13, Number 3. August 1997. pp. 225-242.
- Kadlec, Anthony, and Sue McNeil. *Applying the Governmental Accounting Standards Board's Statement 34: Lessons from the Field*. Paper number 01-3076. Transportation Research Board. Washington, DC. 2001.
- *Asset Management Primer*. Federal Highway Administration, Office of Asset Management, 1999, pp. 7-9.

- *Asset Management: Advancing the State of the Art into the 21st Century through Public-Private Dialogue.* Federal Highway Administration and the American Association of State Highway and Transportation Officials, 1996, p. 3.
- *Asset Management: Preserving a \$1 Trillion Investment.* Focus. Federal Highway Administration. May 2000. pp. 1-2.
- Lemer, Andrew C. *Building Public Works Infrastructure Management Systems for Achieving High Return on Public Assets.* Public Works Management and Policy, Volume 3, Number 3. 1999. pp. 255-272.
- Sheffield, Don. *Innovative Financing: Asset management "Down Under."* APWA Reporter. December/January. 2000. p. 14.
- Dornan, Daniel. *GASB 34's Impacts on Infrastructure Management, Financing & Reporting.* Infrastructure Management Group, Inc. White Paper. June 2000.
- Hudson, Ronald, Ralph Haas, and Waheed Uddin. *Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation, and Renovation.* McGraw-Hill, New York. 1997.
- Shewan, E., Kovacs. *Enterprise-wide Integrated Infrastructure Asset Management.* Public Works, Volume 126, Number 10. September 1995. pp. 66-69.