



Managing Pavements and Monitoring Performance: Best Practices in Australia, Europe, and New Zealand

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Introduction

In the last few years, transportation agencies in the United States have seen the gap between available resources and investment needs widen. At the same time, demand on the infrastructure has been increasing and pressure from the U.S. Congress and State and local governments has been growing to preserve asset conditions and improve transparency and accountability in asset management. These factors have forced agency leaders to reevaluate how they manage assets and adopt innovative and cost-effective strategies for doing more with less.

Internationally, many countries have faced similar challenges and have responded with policies and programs to deal effectively with rising costs, declining revenues, and increasing demands for mobility and growth. They have developed cultures that support a performance-based management approach that accounts for the long-term financial implications associated with system expansion and views transportation decisions from a service-oriented rather than condition-based perspective. The lessons they have learned and the adjustments they have made could benefit transportation agencies in the United States that are considering new strategies for managing transportation assets.

Because pavements represent one of a transportation agency's largest investments, an international scan was conducted to investigate how countries internationally have improved the management of their pavements as they faced the challenges of decreased revenue, deteriorating conditions, and increased public demand for transportation services. The scan, which focused on pavements but was applicable to other assets, was cosponsored by the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO). Richard Tetreault, director of program development and chief engineer for the Vermont Agency of Transportation, and Butch Wlaschin, director of the FHWA Office of Asset Management, served as scan chairs. The scan took place in June 2011. Since the scan was completed, Congress has passed Moving Ahead for Progress in the 21st Century (MAP-21), legislation that supports the use of performance-based programs such as those found internationally. The lessons learned in the evolution of practices used by the international scan participants will benefit

the United States greatly as agencies respond to the accountability requirements outlined in MAP-21.

The scan focused on the following topic areas:

- ❖ Processes for implementing sustainable performance-based programs for managing pavements, and the use of pavement condition information and projections to support programs such as pavement preservation, public-private partnerships, and safety hazard mitigation. This included the use of financial and other incentives for linking pavement budgeting decisions to cost-effective management practices over the life cycle of the pavement.
- ❖ Effective methods for communicating with upper management, legislators, and other stakeholders, including strategies to secure public and legislative support.
- ❖ Agency cultures that support performance-based programs, including effective capacity-building programs. This included strategies for addressing organizational or institutional issues to ensure that a decentralized organization works toward specific performance targets established for the entire network.
- ❖ Techniques, tools, analyses, and reporting mechanisms that support and encourage performance-based management and optimal use of available resources in transportation agencies.

Although the scan team was investigating practices for managing pavements, most of the agencies it met with manage their pavement networks in an asset management framework that considers factors such as strategic fit, effectiveness, efficiency, and risk in determining levels of investment for roads, waterways, rails, and other assets. These agencies operate in a culture in which the long-term implications of their decisions are understood and communicated to decisionmakers using strategic performance measures linked to tactical decisions. Therefore, many of the recommendations have an asset management focus that can be applied to pavements or other transportation infrastructure assets.

Participating Organizations

The transportation agencies and industry representatives selected for the scan had demonstrated the use of sound management principles and philosophies for managing their road (and other) assets. Even though the agencies ranged in size and population, each had implemented systematic processes for preserving and managing its road networks in response to external pressure to improve government efficiency and increase customer satisfaction, even during periods of tightened budgets. Without exception, each transportation agency outsourced most of its road maintenance and restoration activities in response to external pressure. Most incorporated a service-based approach that focused on stakeholder expectations in their road management practices.

The delegates traveled to Australia, England, the Netherlands, New Zealand, and Sweden, where they met with representatives from the agencies shown in table 1.

A separate visit to Adelaide, South Australia, was canceled because of air travel disruptions related to volcanic activity in Chile. South Australia’s Department of Planning, Transport and Infrastructure (formerly the Department for Transport, Energy, and Infrastructure) submitted information to the scan team electronically, and the team conducted a Web conference with agency representatives in June 2012 to discuss their practices.

Table 1. Agencies participating in scan meetings.

New Zealand	Australia	Sweden	Netherlands	England
<ul style="list-style-type: none"> • New Zealand Transport Agency (New Zealand) 	<ul style="list-style-type: none"> • Institute of Public Works Engineering Australia (Sydney, Australia) • Roads Corporation of Victoria (Australia) • South Australia Department of Planning, Transport and Infrastructure (Adelaide, South Australia) via Web conference 	<ul style="list-style-type: none"> • Swedish Transport Administration (Sweden) • Finnish Transport Agency (Finland) • Danish Road Directorate (Denmark) • Norwegian Public Roads Administration (Norway) 	<ul style="list-style-type: none"> • Road Traffic and Transport Authority (the Netherlands) • Institute for Transport Sciences (Hungary) 	<ul style="list-style-type: none"> • Highways Agency (United Kingdom) • Transport for London (London, England) • Transport Scotland (Scotland) • Transport Research Laboratory (United Kingdom)

Key Findings

The economic situation the United States faces is similar to the economic situations many of the countries visited during the scan faced a number of years ago. These agencies, under pressure to improve government efficiency, responded by implementing systematic processes for maintaining the existing road network that emphasized reducing total maintenance and renewal costs over the life of pavements, managing future investment requirements, and minimizing agency risk. Although most of these agencies continue to face declining budgets, they have clearly defined priorities and investment strategies that have been accepted by stakeholders. The stakeholders also understand and accept the resulting impact of these decisions on the condition of the pavement network.

The timing of the scan proved to be extremely beneficial. The facilitated discussions provided the U.S. scan delegates with an opportunity to learn from agencies that had already experienced difficult financial situations and emerged with strong support for road maintenance and renewal among agency leadership, elected officials, and the general public. The challenges they faced and the lessons they learned while evolving their practices led to six key findings:

- ❖ Pavement management is integrated into an asset management culture that supports agency business processes and long-term financial responsibilities.
- ❖ Agencies help elected and appointed officials be better stewards of transportation assets.
- ❖ Agencies focus on outcomes and operate as service providers.
- ❖ Investment priorities are known and stakeholders are held accountable for their actions.
- ❖ Agencies invest in workforce capacity development and succession planning.
- ❖ Efficiency and value drive program delivery approaches.

The scan team noted that although the scan focus was on pavement management, many of the findings relate to the broad application of a systematic process for managing pavements and other transportation assets under constrained conditions. Therefore, the scan findings are equally applicable to pavement manage-

ment and asset management practitioners, as well as other transportation officials striving to obtain the greatest value possible for the funding levels available.

Pavement Management Is Integrated Into an Asset Management Culture That Supports Agency Business Processes and Long-Term Financial Responsibilities

As in the United States, many of the transportation agencies included in the scan face outside pressure to be more efficient even as customer expectations increase and available funding decreases. In response to these pressures, several agencies have implemented systematic processes for maintaining their road networks, improving customer service, and maximizing the value for each dollar spent. These systematic processes focus on decisions that support a long-term vision for a sustainable pavement management program. The resulting framework is driven by an assessment of the whole-life costs of preserving the value of road assets and documenting the information in a long-term financial plan, as shown in figure 1. In several of the

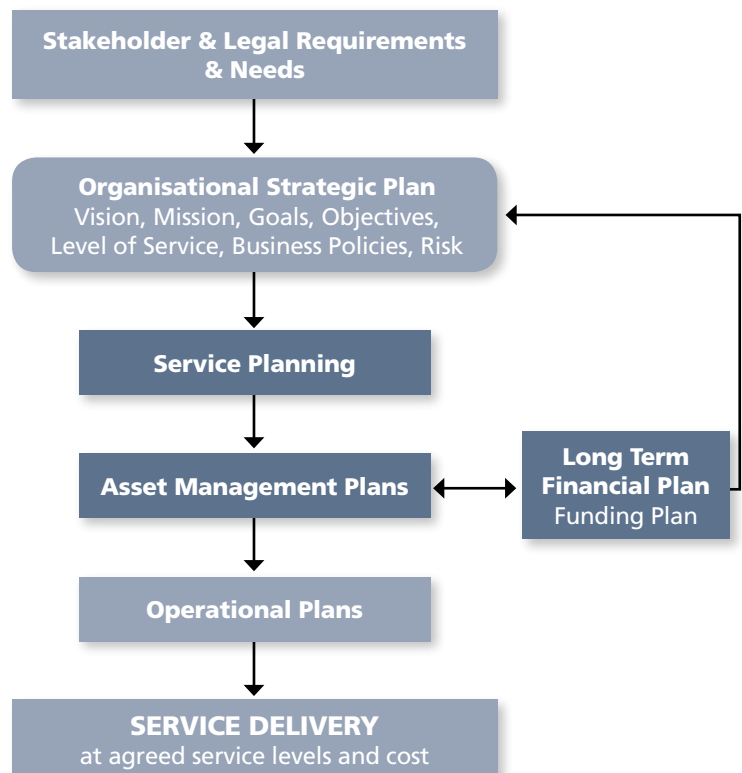


Figure 1. Role of the long-term financial plan (IPWEA).

countries visited, agencies must either fund the depreciation in the road network each year or account for the unfunded liability. The scan team also found more flexibility in programs than is typically observed in the United States. For instance, budgets at Transport for London are fixed over a multiyear period, providing flexibility in shifting projects from one year to the next. This feature was especially important to Transport for London so that construction projects were not scheduled during the 2012 Summer Olympics.

The scan team found that project priorities for road maintenance and renewal were based primarily on reducing agency risk and liability. This has led agencies to take very different approaches to managing their pavement networks. For example, the New Zealand Transport Agency has prioritized seven key state highway routes that have been designated roads of national significance for moving people and freight efficiently and safely between the five largest population centers. VicRoads, on the other hand, considers the deterioration of its low-volume sprayed-seal rural road network a catastrophic risk that would be more cost-prohibitive to address than the robust asphalt network in the urban area. Therefore, preservation of the low-volume road network is a top priority. There was also evidence of multiyear financial plans to manage the road network that provide flexibility to move funding from one year to another and stability because the plans cannot easily be changed once they have been approved.



Figure 2. *Australian Infrastructure Financial Management Guidelines.*

Agencies Help Elected and Appointed Officials Be Better Stewards of Transportation Assets

Some of the countries visited, especially Australia, had a strong use of long-term financial plans at the local level (see figure 2). These financial plans outline the strategies that will be used to effectively manage the road network and communicate risk and deferred liabilities for any underfunded maintenance and renewal activities. The long-term financial plans are developed collaboratively with government officials, who are held accountable for the way public funds are used to preserve the condition of infrastructure assets. As fiscal stewards, elected and appointed officials are responsible for the long-term viability and sustainability of the investment programs.

At several of the agencies the scan team met with, government officials are trained to better understand and honor their fiduciary responsibilities, which has led to support of transportation agency programs at all levels of government. This understanding of stewardship responsibilities was catalytic in supporting performance-based programs in several countries. This support has been especially important because transport agencies internationally do not have dedicated trust funds and must compete for funding.

Agencies Focus on Outcomes and Operate as Service Providers

The agencies that participated in the scan are moving toward a service-based approach for managing their road networks rather than a condition-based approach. Under this service-based approach, customer-driven priorities—such as safety, reliability of travel, comfort, and livability—are becoming the primary drivers for road maintenance and renewal actions. This change in philosophy is considered more meaningful than merely reporting on condition-based performance metrics. It has influenced the types of data collected and the performance targets used to drive the maintenance and renewal program. The New Zealand Transport Agency compared the philosophy to managing a utility. Under a more traditional model, a road may not have been available to carry an unusually heavy load because of existing road conditions. Under a service approach, the agency considers itself responsible for finding a way for the heavy vehicle to use the facility, representing a major shift in its philosophy and the way it approaches programming decisions. Rijkswaterstaat, the executive arm of the Ministry of Infrastructure and the Environment in the Netherlands, bases decisions on the following key performance indicators, which focus almost entirely on service-oriented metrics:

- ❖ Reliability
- ❖ Availability
- ❖ Maintainability
- ❖ Safety
- ❖ Security
- ❖ Health
- ❖ Environment
- ❖ Economics
- ❖ Politics

Transport for London considers risk, customer satisfaction, and cost as the three factors that must be balanced to provide an acceptable level of service, as shown in figure 3. The relationship among these factors and the point at which a zone is established for making investment decisions differ based on the particular asset being investigated. For instance, because most highway users are less aware of bridge conditions than road conditions, risk and whole-life costs are the key decision drivers for that asset and the decision zone shifts to ensure that risks are suitably mitigated. For roadways, customer satisfaction is a much higher decision factor, so the decision zone reflects an effort to maintain it at a high level.



Figure 3. *Transport for London's three-legged stool.*

Investment Priorities Are Known and Stakeholders Are Held Accountable For Their Actions

As in the United States, most of the agencies participating in the scan face significant budget constraints and increasing demands to improve efficiency. In response, many have established clear priorities that emphasize service levels, while assessing the various options based on strategic fit, effectiveness, efficiency, and risk. As a result, these agencies assign the highest priority to maintaining and renewing the existing highway network rather than spending limited dollars on capital enhancements. In some cases, such as England's Highways Agency, the opportunities for expansion are limited because of space constraints. This places even more importance on the agency's emphasis on asset management as a way to maintain the value of the existing road network. The Finnish Transport Agency has developed long-term strategies aimed at maintaining the current condition of the main roads and letting the remainder of the system absorb the funding shortage. Priorities are typically conveyed in an asset management plan. For instance, Transport Scotland publishes a Road Asset Management Plan that sets objectives, targets, and required financial plans that support the government's targets for improving efficiency, reducing casualties, and lessening the impacts of climate change.

To help ensure the implementation of asset management programs, many agencies have established methods for holding agency personnel and contractors responsible for their actions through audits and contractual agreements. The audits the participating agencies used differed dramatically from those commonly used in the United States in important ways. In the United States, audits are used primarily to verify that a process was followed. In the countries participating in the scan, the audits are tied to the asset management plans and long-term financial plans to see how well the agencies carried out their plans. Transport Scotland programs are monitored and reported by the Performance Audit Group and reviewed and endorsed by Audit Scotland, as shown in figure 4 (see next page).

Agencies Invest in Workforce Capacity Development and Succession Planning

The agencies that have successfully navigated a paradigm shift in managing road networks have fostered a culture in which road maintenance and renewal costs are known and the long-term implications of decisions are understood and communicated by decisionmakers at various levels. As a result, these agencies have more mature asset management programs, as evidenced by the branding of asset manage-

ment at Rijkswaterstaat As shown in figure 5, Rijkswaterstaat uses a yellow line as a symbol that connects pavement management with the management of bridges, traffic equipment, and people. The yellow line appears on all asset management materials and is featured prominently in the asset management office.

Without exception, the agencies that participated in the scan have committed to building and retaining internal capacity in asset management. As a result, they demonstrate strong investment in asset management capabilities that result in well-established, trained, and assimilated units in the organizations that all stakeholders, including executives and legislators, look to for information. This focus on training was especially evident in the tools and templates provided by the Institute of Public Works Engineering Australia (IPWEA), an association that supports the implementation of financially sustainable public works programs. As a result, the organization focused on the following actions to lay the framework for infrastructure sustainability:

- ❖ Creating a national framework that addresses the three key elements of building a sustainable community: stewardship (i.e., the role of elected members), asset management planning, and long-term financial planning
- ❖ Providing the tools needed to integrate the technical, financial, and community aspects of managing transportation assets
- ❖ Influencing the development of drivers that support the development of sustainable communities

This three-tier approach and the products developed to support these efforts are shown in figure 6.

In some cases, internal capacity building focused on regaining some of the internal capabilities lost when maintenance and renewal activities were contracted out. However, there is now a sense of urgency in replacing the competencies that were lost and building new capabilities that allow agency personnel to act as smart buyers of future maintenance and renewal services.

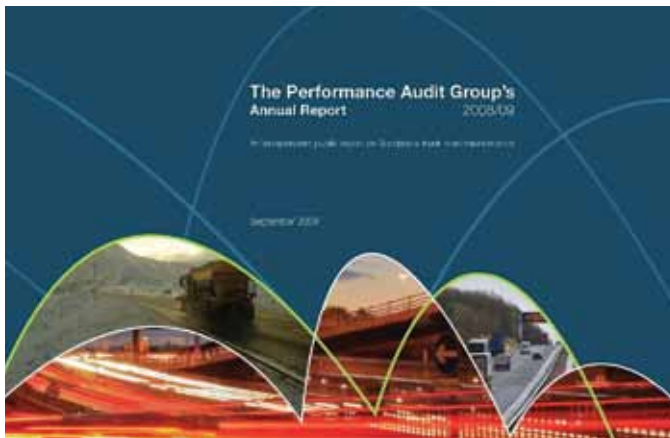


Figure 4. Performance Audit Group Annual Report.



Figure 5. Yellow line used to brand asset management in the Netherlands.

Efficiency and Value Drive Program Delivery Approaches

Most of the participating agencies contract out 100 percent of their pavement maintenance and renewal activities. According to the information the participants provided, these activities were privatized in response to pressure to reduce the debt load or improve efficiency during times of limited funding with a focus on maximizing the value of the investment. Over time, as agencies have gained experience with these types of contracts, contractual terms have evolved, as have the performance metrics that drive the contractor's performance.

The participating agencies were frank about the advantages and disadvantages of contracting for maintenance activities. For example, one advantage is that the cost of programs is known with certainty when the work is outsourced. These contracts have also helped several agencies improve government efficiency. However, several agencies indicated that they lost too much of their maintenance expertise and are in the process of rebuilding it. It has been a challenge to attract and retain skills in the agencies because less engineering is being done internally. They also report that it has been difficult to find the right performance metrics and monopolies may form that limit competition. South Australia's Department of Planning, Transport and Infrastructure found that outsourcing its maintenance activities forced the organization to consider performance requirements from a

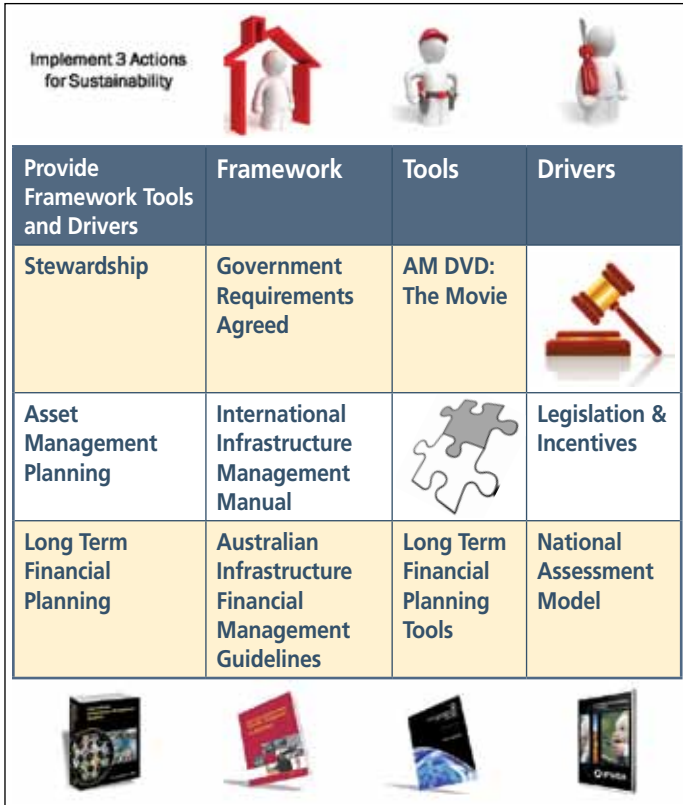


Figure 6. IPWEA's three-tier approach to sustainability.

road user perspective and to link the performance requirements to pavement condition characteristics. Although it was not recognized at the time, the discussions that took place focused informally on managing risk in terms of what risk level was considered acceptable and what was not.

Perhaps the most valuable lesson for the United States is that it takes time to develop contracts that work as planned. Transport Scotland, for example, is using its fourth generation of outsourcing contracts. The Finnish Transport Agency recommends that agencies considering privatized contracts do the following:

- ❖ Develop a good procurement strategy.
- ❖ Use objective road condition measurements.
- ❖ Allow a reasonable level of flexibility in contracts.
- ❖ Develop a cooperative relationship with the private sector.
- ❖ Do not expect immediate benefits.
- ❖ Make improvements to the contracts based on experiences.

Application of Key Findings in the United States

The agencies the team met with during the scan provided a wealth of information that will benefit the United States as its transportation agencies strive to find more effective methods of managing pavements and monitoring performance. The scan yielded a number of strategies for addressing the transportation issues the United States faces today:

1. Performance data and systematic processes are used to evaluate investment strategies. As a result, agencies can respond effectively to pressures caused by decreasing budgets, government efforts to improve efficiency, and increasing customer expectations.
2. Consideration of whole-life costs associated with preserving asset value has been instrumental in shifting agency culture to support asset management and improving agency accountability. By calculating and communicating the long-term maintenance costs associated with system expansion projects, stakeholders have resisted pressure to expand the system without addressing long-term costs. Further, agencies

can determine the financial sustainability of their programs by evaluating the percentage of depreciation funded each year and accounting for any unfunded depreciation as an agency liability.

3. Internationally, there has been a shift toward service-oriented performance measures as a way to address customer-driven priorities such as reliability, availability, maintainability, and safety. These customer expectations must be balanced against funding and risk tolerance when developing an acceptable level of service.
4. The ability to commit funding and projects as part of 4-year programs has been a critical component of an agency's ability to ensure that treatments are applied at the right time to be economical.
5. Holding elected and appointed officials, agency employees, and contractors accountable for their actions has served as a catalyst to the success of

performance-based programs. For instance, government performance audits of agency spending have reduced political interference in program development and have helped ensure that the government gets the best value for its investment.

6. Outsourcing maintenance activities is one way agencies have improved government efficiency, but the programs have not been without challenges. Among other lessons, agencies have learned that they must retain a certain degree of competency to remain smart buyers of the required services.

7. Strong investment in asset management capabilities results in well-established, trained, and assimilated units in the organizations that all stakeholders, including executives and legislators, look to for information. Building and maintaining agency capacity requires skills outside of a traditional civil engineering program. It requires a better understanding of finance, accounting, risk, and communication, among other skills.

Implementation Strategies, Dissemination, and Recommendations

The scan team included representatives from Federal, State, and local agencies to foster the implementation of the findings into the practices of transportation agencies throughout the United States. The representatives from FHWA and State highway agencies have identified strategies that can be implemented through FHWA programs, the National Cooperative Highway Research Program, and State initiatives. The local agency representative will work with FHWA's Local Technical Assistance Program to encourage adoption of the key findings at the city and county levels.

Based on the findings from the scan, the delegates identified the following implementation strategies to foster the use of systematic processes for managing pavements that support performance-based decisions to improve serviceability, accountability, and stewardship in the United States:

- ❖ Develop guidelines for asset management plans and long-term financial plans as the foundation for sound and transparent investment.
- ❖ Improve accountability through the use of program assessments that answer the question "Is the agency working its plan?"
- ❖ Develop agency capabilities.
- ❖ Communicate the findings and introduce the service-oriented approach observed in the agencies visited.

Encouraging use of long-term financial plans and providing technical assistance on how to develop them were the top implementation goals of the scan team. IPWEA has developed

templates for use by local agencies in Australia, and the scan team would like to see similar templates, suitable for State agencies, developed in the United States. The financial plans would make agency funding transparent in the same way that publicly traded stocks are transparent: agencies would have to fund the depreciated value of their assets each year or account for this loss of value to the public as a liability.

Program assessments, termed audits by most of the agencies visited, close the loop between the work plan and the work conducted. The agencies depended on these program assessments to reduce political additions to their work plan because they are held accountable for work completed. The program assessment is a regular part of the business cycle and is a tool to keep the program on track and within budget.

In developing asset management plans, long-term financial plans, and program assessments, the countries found that new skills were required in their agencies. The financial plans require close communication between accountants familiar with depreciation accounting and engineers knowledgeable about maintaining the assets. Data are required and data collection and analysis are necessary for sound decisionmaking. Agencies in the United States will need this marriage of financial accounting and technical expertise, as well as the technology to support asset management.

Communication is an important first and ongoing step in implementing any research or scan findings. Through this executive summary, the scan report, and presentations to committees of AASHTO, FHWA, State and local agencies, and the Transportation Research Board, the scan participants are committed to bringing the value of the scan into U.S. practice.



**OFFICE OF INTERNATIONAL PROGRAMS
FHWA/US DOT (HPIP)**

1200 New Jersey Avenue, SE
Washington, DC 20590
Tel: (202) 366-9636
Fax: (202) 366-9626

international@fhwa.dot.gov
www.international.fhwa.dot.gov