Managing Pavements and Monitoring Performance:

Best Practices in Australia, Europe, and New Zealand

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16. Abstract

U.S. transportation agencies have seen the gap between available resources and investment needs widen while demand on infrastructure and pressure to preserve asset conditions have increased. The Federal Highway Administration, American Association of State Highway and Transportation Officials, and National Cooperative Highway Research Program sponsored a scanning study of Australia, Europe, and New Zealand to learn how international agencies have improved pavement management while facing decreased revenues, deteriorating conditions, and increased demand for transportation services.

The scan team found that in the agencies it studied, pavement management is integrated into an asset management culture that supports agency business processes and long-term financial responsibilities. The team also observed that agencies help officials be better stewards of transportation assets and that they focus on outcomes and operate as service providers.

Team recommendations for U.S. implementation include developing guidelines for asset management plans and long-term financial plans as the foundation for sound investment, improving accountability through the use of program assessments, and introducing the service-oriented approach observed in the international agencies.

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International Technology Scanning Program

The International Technology Scanning Program, sponsored by the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), and the National Cooperative Highway Research Program (NCHRP), evaluates innovative foreign technologies and practices that could significantly benefit U.S. highway transportation systems. This approach allows for advanced technology to be adapted and put into practice much more efficiently without spending scarce research funds to re-create advances already developed by other countries.

FHWA and AASHTO, with recommendations from NCHRP, jointly determine priority topics for teams of U.S. experts to study. Teams in the specific areas being investigated are formed and sent to countries where significant advances and innovations have been made in technology, management practices, organizational structure, program delivery, and financing. Scan teams usually include representatives from FHWA, State departments of transportation, local governments, transportation trade and research groups, the private sector, and academia.

After a scan is completed, team members evaluate findings and develop comprehensive reports, including recommendations for further research and pilot projects to verify the value of adapting innovations for U.S. use. Scan reports, as well as the results of pilot programs and research, are circulated throughout the country to State and local transportation officials and the private sector. Since 1990, more than 85 international scans have been organized on topics such as pavements, bridge construction and maintenance, contracting, intermodal transport, organizational management, winter road maintenance, safety, intelligent transportation systems, planning, and policy.

The International Technology Scanning Program has resulted in significant improvements and savings in road program technologies and practices throughout the United States. In some cases, scan studies have facilitated joint research and technology-sharing projects with international counterparts, further conserving resources and advancing the state of the art. Scan studies have also exposed transportation professionals to remarkable advancements and inspired implementation of hundreds of innovations. The result: large savings of research dollars and time, as well as significant improvements in the Nation's transportation system.

Scan reports can be obtained through FHWA free of charge by e-mailing international@dot.gov. Scan reports are also available electronically and can be accessed on the FHWA Office of International Programs Web site at www.international.fhwa.dot.gov.

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Northumberland Strait Crossing Project (1996)

European Bridge Structures (1995)

All publications are available on the Internet at www.international.fhwa.dot.gov.

Abbreviations and Acronyms

AASHTO
American Association of State Highway and Transportation Officials

DOT
department of transportation

DPTI
Department of Planning, Transport and Infrastructure

FHWA
Federal Highway Administration

GIS
geographic information system

GPS
Government Policy Statement

IPWEA
Institute of Public Works Engineering Australia

IT
information technology

ITS
intelligent transportation system

KPI
key performance indicator

LOS
level of service

MMS
maintenance management system

NCHRP
National Cooperative Highway Research Program

NZTA
New Zealand Transport Agency

NPRA
Norwegian Public Roads Administration

SLA
service-level agreement

TRB
Transportation Research Board

TRL
Transport Research Laboratory

VicRoads
Roads Corporation of Victoria

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Executive Summary

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 network 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 following agencies:

- New Zealand Transport Agency (New Zealand)
- Institute of Public Works Engineering Australia (Sydney, Australia)
- Roads Corporation of Victoria (Australia)
- Swedish Transport Administration (Sweden)
- Finnish Transport Agency (Finland)
- Danish Road Directorate (Denmark)
- Norwegian Public Roads Administration (Norway)
- Road Traffic and Transport Authority (the Netherlands)
- Institute for Transport Sciences (Hungary)
- Highways Agency (United Kingdom)
- Transport for London (London, England)
- Transport Scotland (Scotland)
- Transport Research Laboratory (United Kingdom)

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.

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 management 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. In several of the 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, the 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.

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. 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. 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.

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.

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. This is evidenced by the branding of asset management at Rijkswaterstaat, which 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, 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

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.

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 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.

Chapter 1. Introduction

Numerous publications report that the condition of highway pavements in the United States has declined in recent years.[1] Rising costs, increasing traffic, expansion, a worst-first approach to selecting capital projects, and the age of the infrastructure have all been cited as reasons for this deterioration. As a result of these factors, the gap between available resources and investment needs has widened. At the same time, there is growing pressure from the U.S. Congress and State and local governments 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.

The Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO) have supported the use of a performance-based management approach as one strategy for managing assets effectively. While performance-based management approaches have been used in industrial and commercial applications in the United States and abroad for many years, the adoption of these practices at U.S. public agencies has been slow because of disconnects between actual infrastructure performance (conditions) and decision-making on financial investment in the highway network, particularly when looking at long-term economics. These disconnects appear to have been related to a lack of quality information, an inability to make meaningful projections linking investments to actual performance (impacting system credibility), and a perception that a business approach is not appropriate for public infrastructure. In addition, during eras of economic growth, such as the one the United States experienced in the mid-1990s, increasing revenues easily offset rising expenditures, which tended to mask the need to address long-term, sustainable solutions.

Internationally, countries such as Australia, England, New Zealand, and Scotland have faced similar challenges and have responded with policies and programs to effectively deal with rising costs, declining revenues, and increasing demands for mobility and growth. They have developed and fostered 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 a 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.

To learn how others have successfully addressed these challenges and how the practices could be adapted in the United States, AASHTO and FHWA undertook an international scan. The scan focused on pavement management because pavements represent one of a transportation agency's largest investments. 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 to 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.

[1] *The Road Information Project: Key Facts About America's Road and Bridge Conditions and Federal Funding* (2008), *U.S. DOT Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (2006), and *Report of the National Surface Transportation Policy and Revenue Study Commission—Transportation for Tomorrow* (2007).

Although the scan team was investigating practices for managing pavements, most of the agencies it met with manage their pavement network 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.

Scan Team

The scan team was cochaired by Richard Tetreault, director of program development and chief engineer for the Vermont Agency of Transportation, and Butch Wlaschin, director of the Office of Asset Management for FHWA. They were joined by representatives of State and Federal highway agencies, academia, and private industry:

- **Tom Baker,** State materials engineer, Washington State Department of Transportation (DOT)
- **Tim Colling,** director of the Center for Technology and Training at the Michigan Tech Transportation Institute, Michigan Tech University
- **Judith Corley-Lay,** State pavement management engineer, North Carolina DOT
- **Kevin McLaury,** division administrator, FHWA Montana Division
- **Nastaran Saadatmand,** pavement management program manager, FHWA
- **Roger Safford,** region engineer, Michigan DOT, and member, Michigan Transportation Asset Management Council
- **Katie Zimmerman,** president, Applied Pavement Technology, Inc., and report facilitator

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 participants represented agencies that 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 100 percent 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 organizations 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,

Table 1. Agencies participating in scan meetings.

New Zealand	Australia	Sweden	Netherlands	England
• New Zealand Transport Agency (New Zealand)	• 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	• Swedish Transport Administration (Sweden) • Finnish Transport Agency (Finland) • Danish Road Directorate (Denmark) • Norwegian Public Roads Administration (Norway)	• Road Traffic and Transport Authority (the Netherlands) • Institute for Transport Sciences (Hungary)	• Highways Agency (United Kingdom) • Transport for London (London, England) • Transport Scotland (Scotland) • Transport Research Laboratory (United Kingdom)

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.

Pavement Management Perspective and Terminology

Although the scan focus was on pavement management policies and practices, some of the agencies visited conduct pavement management in an asset management framework that considers factors such as strategic fit, effectiveness, efficiency, and risk in determining levels of investment for each asset.[2] 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. While the focus of the findings and recommendations is on the use of asset management principles and tools for managing pavements, it is understood that the same concepts have also been applied successfully to other transportation infrastructure assets.

These asset management principles and practices are integral to the development of the strategic goals and performance targets in these agencies. From that perspective, the practices identified during the scan are similar to the performance management functions that have been defined in the United States.

The scan team also identified differences in the terminology used in the United States and abroad. For example, U.S. transportation agencies commonly refer to pavement preservation as planned treatments that are applied to pavements in relatively good condition to restore or preserve their functional condition. In the countries visited during this scan, representatives referred to these types of noncapital activities as maintenance and renewal treatments. Capital improvements were often funded differently than maintenance and renewal activities and were not a major focus of the scan. Other differences in terminology are clarified in the report as necessary.

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 pavement, 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 to the participants. The facilitated discussions provided an opportunity for the scan participants 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 lessons learned from the technology exchange with these individuals 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 management and asset management practitioners, as well as other transportation officials striving to obtain the greatest value possible for the funding levels available.

Report Organization

The report is organized around the scan's key findings, with supporting information from the agencies visited during the scan in each chapter. Chapter 2 summarizes the key characteristics of the agencies visited. The supporting information on each of the key findings is presented in Chapters 3 through 8. Each chapter profiles some of the practices the team discovered during the scan and concludes with team

[2] These assets include roads, waterways, rail, and other assets.

members' key observations. Chapter 3 presents the steps the international agencies and associations have taken to build an asset management culture that supports each agency's business process and considers long-term financial responsibilities. Chapter 4 examines what agencies have done to help elected and appointed officials be better stewards of transportation assets. Chapter 5 presents information on the focus of many of the organizations as service providers. As discussed in this chapter, the emphasis on providing a service to the traveling public has had a significant impact on the types of performance measures used and the level of service provided. Chapter 6 examines the priorities the participating agencies have established and the strategies they use to hold stakeholders accountable. Chapter 7 addresses the investments the agencies have made in workforce development and succession planning, and Chapter 8 summarizes the program delivery mechanisms agencies have adopted to improve efficiency and value. Chapter 9 presents the lessons learned from the scan, and Chapter 10 describes recommended implementation activities to integrate some of the findings into the state of practice in the United States.

References to monetary amounts are reported in the country's own currency. Distance measurements are generally presented in metric units, but conversions to English units are included in the body of the report. No attempts were made to modify graphics provided by the participating agencies, even if different currencies or metric units were used.

Chapter 2. Overview of Participating Agencies

The scan team met with representatives from 14 agencies in Australia, Europe, and New Zealand. The agencies were selected based on a desk scan of international practices used to manage pavements and monitor performance. To provide a context to better understand the references to organizational practices described in the report, this chapter summarizes the primary characteristics of the practices found in each agency.

New Zealand and Australia

New Zealand Transport Agency, Wellington, New Zealand

At the time of the scan, the New Zealand Transport Agency (NZTA, www.nzta.govt.nz) had been in operation for about 3 years, having recently widened its scope by adding the rail network to its responsibilities. The State Highway Network includes 10,909 centerline kilometers (km) (6,779 miles (mi)) of road, which carry nearly 20,000 million vehicle-km per year. The agency's assets are reportedly worth about NZD23 billion, and annual investments total about NZD1.5 billion in state highways and about NZD650 million in local roads.[3] The Land Transport Management Act of 2003 is the legal framework for managing and funding land transport activities in New Zealand. The act provides for a Government Policy Statement (GPS), which sets the strategic direction for investment in the land transport section, allocates funding to activity classes in the National Land Transport Programme, highlights expected impacts from transport investments, and identifies roads of national significance that are priorities for completion. In addition, the GPS requires NZTA to use an integrated approach to transport planning that addresses all transport modes and land uses. Priorities incorporated into the agency's strategic plan include the following:

- Delivering the roads of national significance
- Improving road safety
- Improving customer service
- Improving public transport
- Improving freight movement efficiency

[3] New Zealand Transport Agency (2010). *Our Strategic Direction 2010-2013.* New Zealand Transport Agency, Wellington, New Zealand.

The agency provides advice to the Ministry of Transport, but considers itself to have primary responsibility for managing the transport system. Virtually all of its work is outsourced, including the design, maintenance, and management of the network. To retain competency in the agency, a Professional Service Group was developed to set performance requirements for contractors. Efforts are underway to ensure that critical infrastructure decisions receive national scrutiny and that the agency continues to be a knowledgeable client. Improvement projects and network management and maintenance are delivered through outsourced contracts managed from one of nine regional offices, but the strategic direction and priorities come from the national office in Wellington.

Department of Planning, Transport and Infrastructure, Adelaide, South Australia

South Australia is comparable in size to Texas, but one of the major differences is the low density of population in the country. More than 70 percent of the population lives in Adelaide, so one of the agency's challenges is managing the long distances between small, rural towns. Because the state is home to manufacturing facilities, mining, agriculture, and forestry, the road network gets intensive freight use.

The Department of Planning, Transport, and Infrastructure (DPTI, www.dpti.sa.gov.au) maintains 12,650 centerline km (7,860 mi) of sealed roads and 10,000 km (6,214 mi) of unsealed roads. In addition, the agency is responsible for maintaining 1,500 bridges and major culverts, two tunnels, more than 700 signal systems, and 12 ferries. Local governments, considered the third tier of government in Australia, manage about 15,000 km (9,321 mi) of sealed roads and 60,000 km (37,282 mi) of unsealed roads. The national government and the state government represent the first and second tiers of government.

Funding for constructing and maintaining roads and bridges across South Australia is predominantly provided through the allocation of the State Highways Fund, which is administered under the Highways Act of 1926 and consists of money collected from drivers' license and motor vehicle registration fees. State funding is provided in 4-year estimates. In addition to state funding, which represents about 67 percent of the total funding, DPTI receives federal funding from the Australian government as part of a 5-year

agreement. About 65 percent of the total funding is spent on pavements.

The agency's *Strategic Infrastructure Plan for South Australia*[4] outlines six strategic priorities for the agency:

- Invest in transport infrastructure.
- Improve competitiveness through efficient freight transport networks and improved international links.
- Facilitate redevelopment of the state's export and import ports.
- Minimize the impact of freight vehicle movements on the community and the environment by appropriately locating freight routes.
- Reduce injuries and fatalities from transport crashes.
- Concentrate resources on maintaining and improving existing assets.

Only the last of the six priorities focuses on asset management, although some of the other priorities are interconnected with asset management. For example, improvements in freight transport may lead to higher loads that may increase the rate at which the road network deteriorates. One of DPTI's challenges is to balance asset and pavement needs with broader transport issues within the available budgets. The focus on a broad range of transport priorities and the shift from internal provision of construction and maintenance activities to primarily external providers have transformed the organizational culture dramatically. As a result, the agency has had to focus more on establishing performance requirements from a customer's perspective.

VicRoads, Melbourne, Australia

Although Victoria is geographically one of the smallest areas of Australia, nearly a quarter of the Australian population lives in this state. Victoria is also home to about a third of the motor vehicles registered in Australia and a quarter of the country's freight tonnage. As the state road and traffic management authority for Victoria, the Roads Corporation of Victoria (VicRoads, www.vicroads.vic.gov.au/home) is responsible for maintaining 22,000 carriageway km (13,670 mi), or about 55,000 lane km, of arterial road network, which includes 3,000 bridges. These assets have a depreciated value of AUD23 billion (about AUD38 billion replacement cost) and the annual program has a budget of about AUD1.9 billion. VicRoads employs about 3,100 professional, technical, and customer service staff in seven regions. The federal government is responsible for the road network that provides linkages benefiting the country as a whole, and local governments are responsible for the local road network using federal funds.

VicRoads has five principal aims that influence agency priorities:

- Achieve ongoing reductions in the number and severity of road crashes and the resultant cost of road trauma.
- Assist economic and regional development by managing and improving the effectiveness and efficiency of the road transport system.
- Develop a more integrated and sustainable road transport system.
- Enhance the environment through the responsible planning and management of the transport system.
- Deliver cost-effective and customer-focused service to the community.

Most of the arterial road network in Melbourne consists of flexible pavements built with crushed rock with an asphalt (bituminous concrete) surface that is typically 2 to 4 inches (51 to 102 millimeters) thick. Throughout the rest of the state, most of the roads are spray seals (also known as chip seals). These designs serve as a low-cost, all-weather system, so maintenance focuses on preventing the pavement structures from failing. Interventions are scheduled to address minor defects to keep the road safe, but also to prevent the minor defect from becoming more expensive to repair. Intermediate resurfacing of the routes is planned on a 13- to 14-year cycle, and restoration work is conducted on about 1 to 2 percent of the network a year if funding is sufficient to address other needs. Because of funding shortfalls in recent years, roads in poor condition are not being restored and VicRoads has elected to allow those roads to deteriorate further because there is no large difference in repair costs once the road is in bad condition. The agency has determined that its highest risk is losing the low-volume road network, so the majority of funding is targeted at preserving the condition of that network.

[4] Department of Planning, Transport and Infrastructure (2005). *Strategic Infrastructure Plan for South Australia.* Department of Planning, Transport and Infrastructure Adelaide, South Australia.

Most of the maintenance work is performed by contract forces based on broad parameters on the number of miles to be covered annually in each region. Each region prioritizes and selects the projects it will complete using a risk-based analysis that considers factors such as route use and traffic volumes.

Institute of Public Works Engineering Australia

The Institute of Public Works Engineering Australia (IPWEA, www.ipwea.org.au/home) is a professional association that provides its members with training, templates, guidance, and advocacy to support the delivery of public works and engineering services. A primary focus of IPWEA is on implementing financially sustainable public works programs. As a result, the organization focuses 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 technical, financial, and community aspects with managing transportation assets
- Influencing the development of drivers that support the development of sustainable communities

This three-tier approach and the products that have been developed to support these efforts are reflected in figure 1.

Figure 1. *Support provided by IPWEA.*

The products include the *International Infrastructure Management Manual,* which establishes the framework for asset management planning activities, the *Australian Infrastructure Financial Management Guidelines,* which assists with the development of long-term financial plans, and Practice Notes on condition assessment, long-term financial planning, and asset management for small communities. In addition, IPWEA provides training, videos, and information exchange to support these efforts. IPWEA recently partnered with the Centre for Pavement Engineering Education to develop a graduate certificate program in infrastructure asset management that is accredited by the University of Tasmania. IPWEA strongly encourages agencies to just start using asset management principles and to improve the amount and quality of data over time.

Europe

Swedish Transport Administration, Stockholm, Sweden

The Swedish Transport Administration (www.trafikverket.se/om-trafikverket/andra-sprak/english-engelska) is responsible for the construction, operation, and maintenance of all state-owned roads and railways. The network includes nearly 100,000 km (62,137 mi) of government-owned roads and 12,000 km (7,456 mi) of railways. In addition to the state-maintained roads, there are about 41,000 km (25,476 mi) of municipal streets and roads and 76,100 km (47,286 mi) of private roads that are managed with a state grant. Its six districts include Stockholm, which is a single district. Funding for road maintenance is tight, with recent budgets at all-time lows for paved road maintenance, surface measurements, road markings, and drainage.

Norwegian Public Roads Administration, Oslo, Norway

The Norwegian Public Roads Administration (NPRA, www.regjeringen.no/en/dep/sd/about-the-ministry/subordinate-agencies-and-enterprises/norwegian-public-roads-administration.html?id=443412) was one of the transport agencies the scan team visited that is not multimodal. The agency focuses on the planning, construction, operation, and maintenance of the national and county road network, which includes 93,214 km of national roads, some of which are county roads (44,000 km (27,340 mi)) and some of which are considered to be municipal roads (38,515 km (23,932 mi)). The county provides funding for county roads, and NPRA administers the contracts for maintenance. Roads receive about NOK61 billion of the total budget for transport, which is estimated at NOK322 billion. Routine pavement maintenance and rehabilitation activities are performed by contractors under annual maintenance contracts. At the time of the visit, three contractors had responsibility for nearly 75 percent of the total amount awarded in contracts, and NPRA has noticed that costs are increasing each year. Current funding levels are adequate for stabilizing road conditions, but are not sufficient for improving them.

Finnish Transport Agency, Helsinki, Finland

The Finnish Transport Agency (http://portal.liikennevirasto.fi/sivu/www/e) is responsible for maintaining and managing state-owned roads, railways, and waterways. The agency spends about €609 million a year on basic road maintenance, which represents about 60 percent of the total funding available for infrastructure management. The road network consists of 78,200 km (48,591 mi) of public roads, which includes about 13,300 km (8,264 mi) of main roads, 765 km (475 mi) of motorways, and around 5,600 km (3,480 mi) of pedestrian and bicycle lanes, which are considered road equivalents. There are also about 14,600 bridges in the network.

The agency has nine regional offices, which are directed by the Ministry of Employment and the Economy. The Finnish Transport Agency is under the direction of the Ministry of Traffic and Communication. There have been challenges associated with coordinating the program because the central office (i.e., the Finnish Transport Agency) is directed by a different ministry than the users of the funds (i.e., the regional offices). Road improvements are funded entirely by the state budget with no revenue generated by taxes. Road maintenance strategies are outlined over a 4-year program, so pavement management strategies are somewhat stable over that time period.

Since 2004, the maintenance, rehabilitation, and operation of the road network have been entirely contracted out, with only traffic management performed in-house. Routine maintenance contracts are 5 to 7 years in length, but pavement maintenance and rehabilitation contracts are primarily annual contracts. There are about five main paving contractors, and most contractors are now required to provide 3-year guarantees on workmanship.

Danish Road Directorate, Copenhagen, Denmark

The Danish Road Directorate (http://vejdirektoratet.dk/EN/Pages/default.aspx) is a public authority under the direction of the Ministry of Transport. The directorate is responsible for the construction, extension, development, operation, and maintenance of the state road network. This network includes 3,788 km (2,356 mi), which represents about 5 percent of the entire public road network in Denmark. However, nearly 45 percent of all road traffic travels on these state roads. The Danish Road Directorate has been decentralized since 2009, and in 2012 three regional centers were established with responsibility for using the funds they are provided. All activities are contracted out and there are 4-year contracts for routine maintenance. Funding for road improvements is based 100 percent on taxes.

Rijkswaterstaat, Delft, Netherlands

Rijkswaterstaat (www.rijkswaterstaat.nl/en) is the executive agency responsible for the design, construction, maintenance, and management of the main national public works and waterway infrastructure on behalf of the new Ministry of Infrastructure and the Environment (formerly known as the Ministry of Transport) and the State Secretary for Transport, Public Works, and Water Management. The organization has a budget of about €4 billion to €5 billion and employs about 9,000 employees. The road network includes 3,250 km (2,019 mi) of highways. The agency has 10 regional departments, which include 19 road districts and 16 water districts, and five specialized departments.

Rijkswaterstaat works to ensure that the Dutch communities have the following:

- Dry feet[5]
- Sufficient clean water
- A smooth and safe flow of transport on the nation's roads and waterways
- Reliable and useful information

Asset management is ingrained in the organization's culture at all levels. Roles and responsibilities are clearly defined for the asset owner, asset manager, and service provider, as illustrated in figure 2. The asset owners are responsible for setting the future strategic goals for the network through a consideration of targets, risk, and cost. The asset manager develops tactical plans and investment strategies, and the service providers are responsible for operations, including renewal, expansion, and maintenance. In summary, the asset owners provide money, the asset manager provides knowledge, and the service provider provides the people needed to do the work. All of the maintenance activities are contracted out using 5- to 7-year contracts.

Asset Owner

- Future of the network (strategic)
- Framework
  - Targets
  - Risk
  - Cost

Asset Manager

- Tactical plan
  - Investment strategies
  - Maintenance concept
  - Technology standard
- Program Management
  - Risk management
  - Network management
  - Performance management

Service Provider

- Operations
  - Renewal
  - Expansions
  - Maintenance
  - Project management
  - Process
  - Asset data management

Figure 2. *Rijkswaterstaat roles and responsibilities.*

[5] Because the Netherlands is below sea level, managing water is a high priority for the agency.

In addition to its recent name change, the agency reports that it is in transition and seeking new balance. Stakeholders, politicians, and the market all have different expectations for transport. Politicians want the cheapest approach, users want a system that is always available with no congestion, contractors want clarity on what needs to be achieved, and the public wants a safe place with dry feet. An organization that contracts out 100 percent of its maintenance and renewal activities, the agency relies on asset management to provide the knowledge needed to make decisions and the contract conditions to stimulate contractors to deliver optimal quality. The agency faces mandatory budget reductions of 20 percent, which will be addressed primarily through staff reductions. As a result of these changes, the representatives from Rijkswaterstaat stressed the importance of communication between technical and managerial levels.

Institute for Transport Sciences, Budapest, Hungary

According to representatives of the Institute for Transport Sciences (www.euromar-bridges.eu/index.php?id=kti), the Hungarian infrastructure includes 31,500 km (19,573 mi) of national public roads, 140,000 km (86,992 mi) of local (municipal) public roads, and 6,900 bridges. Since the 1990s, one of the primary focuses in the country has been to develop the motorway at a rate of about 30 to 50 km (19 to 31 mi) per year. Funding for the maintenance of the road network has not been adequate to preserve network conditions, with only about 0.7 to 0.8 percent of the gross value invested in the network each year. However, because of the addition of new motorway mileage each year, the average condition of the network is increasing, which masks the deterioration of the rest of the system. Therefore, it has been a challenge to effectively communicate needs.

To help estimate future needs, 60 pavement sections have been established to represent the performance of 14 different pavement families. These sections are monitored regularly to help establish relationships that can be modeled. These new models will replace the Markov Transition Probability Matrices that have been in use since the 1980s.

Highways Agency, London, England

The Highways Agency (www.highways.gov.uk) is an executive agency of the Department for Transport responsible for operating, maintaining, and improving England's strategic road network on behalf of the

Secretary of State for Transport. The Department for Transport sets policy and reports directly to Parliament and secures funds from the Treasury. This organizational structure is depicted in figure 3.

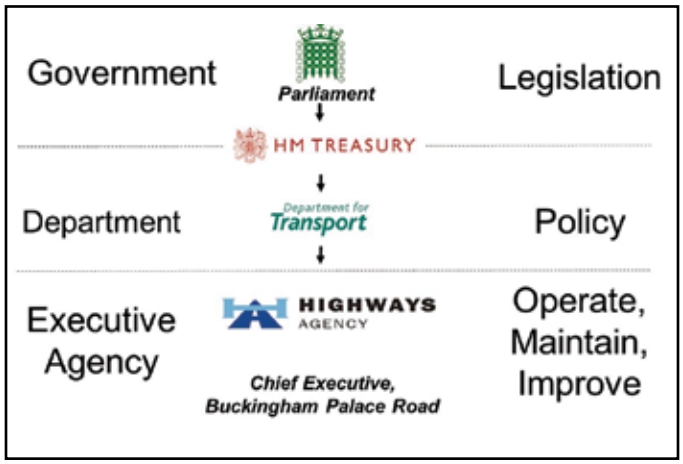

Figure 3. *Transport roles, responsibilities, and governance in England.*

The national road network includes 7,200 km (4,474 mi) of roads that include motorways and single carriageway trunk roads with a total value of about £100 billion. This road network carries about a third of all the road traffic and nearly two-thirds of all heavy freight traffic in England. Each motorway carries between 30,000 and 200,000 vehicles per day and costs over £2 billion to manage each year. Demand for the facilities is growing each year, and increased competition for funding is expected to add to the challenges of managing this network. Funding for maintenance of the road network comes from public tax revenue. The agency was fortunate to get an additional £500 million for maintaining the road network for the past several years, but it expects funding to return to more typical levels in the coming years because the Department of Transport must compete with other social agencies for funds and the Highways Agency must compete with other groups in the Department of Transport for funds.

The Highways Agency's *Strategic Plan for 2010–15* outlines the following strategic goals:

- Provide a service our customers can trust.
- Set the standard for delivery.
- Deliver sustainable solutions.
- Provide the safest roads in the world.
- Provide a dynamic and resilient asset.

These goals are underpinned by a philosophy that the agency must be able to deliver more with less. The agency expects this to mean that it will have to eliminate some items that have been considered nice to have and coordinate efforts to obtain the information it needs. As a result, the agency has spent more time up front making sure it does the right thing on each project, plans each job correctly, and builds at a time that minimizes interruption to customers while ensuring that safety is not compromised. This focus on efficiency demands that employees and contractors have the skills to perform their duties, so the Highways Agency has established a plan to build internal capability through the following:

- Greater innovation
- Inspired leadership
- Improved professionalism
- Clearer communication
- Smarter collaboration

Roles, responsibilities, and governance are clearly identified, with the top tier of government (i.e., Parliament) passing legislation, the middle tier (i.e., Department for Transport) setting policy, and the bottom tier (i.e., Highways Agency) carrying out tactics. The *Highways Agency Framework Document*[6] is required by the Treasury to set out the relationship between the Department for Transport and the Highways Agency. The document was last reviewed in 2009 and is updated on a 5-year cycle.

The Treasury issues funding guidelines for the departments on a 4-year cycle.[7] Annual business plans are prepared by the Department for Transport and the Highways Agency[8] to document planned budget expenditures and expected performance measures. The annual report[9] prepared by the Highways Agency documents each year's achievements. The accounts are audited by the National Audit Office and reported to Parliament in terms of the outcomes met for the money received. As discussed in this report, these

[6]Highways Agency (2009). *The Highways Agency Framework Document.* Highways Agency, London, England (www.highways.gov.uk/aboutus/documents/090708_version_of_Highways_Framework.pdf).

[7]HM Treasury (2010). *The Spending Review Framework.* HM Treasury, London, England (www.hm-treasury.gov.uk/d/spending_review_framework_080610.pdf).

[8]Highways Agency (2011). *Business Plan 2012–2013.* Highways Agency, London, England (www.highways.gov.uk/aboutus/34742.aspx).

[9]Highways Agency (2011). *Annual Report 2010–2011.* Highways Agency, London, England (www.highways.gov.uk/aboutus/32107.aspx).

audits differ from audits conducted in the United States because they focus more on accomplishment of the achievements outlined in the plan than on verifying that procedures were followed.

Transport for London, London, England

Transport for London (www.tfl.gov.uk) was created in July 2000 as part of the Greater London Authority. The agency is accountable to an elected mayor and is the single integrated organization responsible for London's seven modes of transport. As shown in figure 4, the agency manages a wide range of assets, including carriageways, footways and cycle routes, structures, tunnels, street lighting, drainage, traffic signals, cameras, variable message signs, overheight vehicle detection systems, and green estate. The Transport for London road network consists of 580 km (360 mi) of London's most heavily traveled roads. Although this road network represents only 5 percent of the roads in London, it carries 30 percent of the total traffic and 50 percent of the city's freight traffic.

The annual budget for capital renewal is about £80 million. About £160 million is spent on revenue maintenance. Broad goals and strategies for managing the transport system are outlined in the *Mayor's Transport Strategy*.[10] Several outcomes relate to asset management, such as the following:

- Bringing and maintaining all assets to a state of good repair
- Reducing operating costs
- Smoothing traffic flow
- Improving user satisfaction

In response, Transport for London developed its Highway Asset Management Framework, which conveys how it will deliver the outcomes outlined in the *Mayor's Transport Strategy*. The document includes a section on business management and another on highway asset management. The Highway Asset Management Framework links an investment strategy to the expected levels of service and evaluates performance to determine the value received for the money spent. The results of the analysis were first published in 2007 in the *Transport for London Highway Asset Management Plan*.[11] A new version of the document was expected to be published soon after the scan.

Transport for London has a long history of emphasizing the efficient and effective management of its existing assets and instituting means of reporting outcomes. One factor that has influenced the focus on managing existing assets is the limited space around London for growth to occur. As a result, there has been little pressure on the agency for expansion activities and asset management has become part of the day-to-day activities of the organization.

Asset type	Quantity
Carriageway	580 network km 2,555 lane km
Footways & Cycle Routes	Over 1,200 km of footway 197 km of dedicated cycle lanes
Structures	513 bridges, 123 culverts, 696 retaining walls & 304 subways
Tunnels	13 major tunnels
Street Lighting	Over 40,000 (of about 550,000 in London)
Drainage	Over 45,000 gullies
Traffic Signals	6,187 units
Cameras	2,471 units
Variable Message Signs	164 units
Overheight Vehicle Detection Systems	54 units
Green Estate	Over 40,000 trees and over 700 acres of grass, trees & verges

Figure 4. *Assets managed by Transport for London.*

Transport Scotland, Glasgow, Scotland

Transport Scotland (www.transportscotland.gov.uk) is the national transport agency for Scotland, which is responsible for delivering the government's capital trunk road and rail investment program. In addition, the agency operates national concessionary travel, integrated ticketing schemes, and lifeline air and ferry services. The agency has more than 400 employees in Glasgow and manages a network of about

[10] Mayor of London (2010). *Mayor's Transport Strategy.* Greater London Authority, London, England (www.london.gov.uk/publication/mayors-transport-strategy).

[11] Transport for London (2007). *Transport for London Highway Asset Management Plan.* Transport for London, London, England (www.tfl.gov.uk/assets/downloads/businessandpartners/HAMP-2Oct.pdf).

3,400 km (2,113 mi) of roads. The agency spends about £150 million on maintenance annually.

The primary focus of Transport Scotland is to invest transport funding in areas that support government priorities in crucial areas. The most recent corporate plan[12] describes the following delivery priorities:

- Improved connections across Scotland
- Better journey times and better reliability
- Greener transport alternatives and reduced emissions
- Increased safety and more innovation

Transport Scotland has contractual agreements with four operating companies to provide professional services associated with managing and maintaining the transport network. These companies administer major maintenance contracts and are required to tender any treatments that will exceed £250,000 in costs. A Performance Audit Group monitors the performance of the operating companies. Audit Scotland reviews and endorses the maintenance contracts. Transport Scotland makes a conscience effort to recruit and grow small- and medium-sized enterprises through these contracting arrangements, which use about 40 percent of the maintenance budget.

Transport Scotland has three teams: Asset Management, Network Maintenance, and Network Operations. Although the teams are independent, they work together to manage the transport network. The agency faces many challenges similar to organizations in the United States, including reduced budgets, government performance targets for organizational efficiency and road casualty reductions, and expectations to minimize negative impacts on the climate and the environment. It has a well-developed *Road Asset Management Plan*[13] that sets out the agency's objectives, targets, and required financial plans. However, current funding scenarios are not adequate to meet performance targets. Further complicating the issue are the government's targets to improve efficiency in all branches by 2 percent each year.

[12] Transport Scotland (2008). *Transport Scotland Corporate Plan.* Transport Scotland, Glasgow, Scotland (www.transportscotland.gov.uk).

[13] Transport Scotland (2007). *Road Asset Management Plan.* Transport Scotland, Glasgow, Scotland (www.transportscotland.gov.uk/road/maintenance/prioritising-and-maintaining/prioritising-road-maintenance/RAMP).

Transport Research Laboratory, Berkshire, United Kingdom

The Transport Research Laboratory (TRL, www.tri.co.uk) is the United Kingdom's leading independent center for international transport research, providing advice on and solutions to transport issues. TRL has established partnerships with a number of government agencies in the United Kingdom, providing specialized transport expertise in several subject areas. Under this type of partnership, TRL is responsible for the development, operation, and accreditation of specialized equipment that collects pavement condition information at near-traffic speeds for England's Highways Agency. TRL performs similar processes for local authorities in the United Kingdom, including Transport for London. TRL manages and audits an extensive array of data collection equipment for the Highways Agency, including vehicles to collect surface distress, roughness, skid resistance, surface texture, structural condition, and construction thickness using ground-penetrating radar. Much of the information this equipment collects is stored in the Highways Agency's pavement management software for use in highway management activities. In addition to collecting data, TRL also serves as a consultant to government agencies in the United Kingdom. For instance, TRL has developed a whole-life cost analysis program for the Highways Agency and assists in developing and reporting key performance measures. In 2011–2012, about 45 percent (£20 million) of TRL's revenue was from work for government agencies in the United Kingdom.

Chapter 3. The Asset Management Culture Supports Agency Business Processes and Long-Term Financial Responsibilities

As in the United States, many of the transportation agencies in the countries included in the scan face outside pressure to be more efficient, even as customer expectations increase and 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 they receive 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 assessing the whole-life costs of preserving the value of the road assets and documenting the information in a long-term financial plan. In several of the 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 typically observed in the United States. For example, 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, NZTA has prioritized seven key state highway routes that are designated roads of national significance for moving people and freight efficiently and safely between the five largest population centers. However, the NZTA board has also made it clear that maintaining current levels of service and asset condition is also a high priority and that it wishes to be involved in any discussion of financial constraints that affect service level delivery in either area. NZTA has a 3-year funding cycle in which the only practical constraint is that expenditure must roughly match the revenue stream generated by road users. VicRoads considers the deterioration of its low-volume road network a catastrophic risk that would be cost-prohibitive to address. Therefore, the 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 in moving funding from one year to another and stability because the plans cannot easily be changed once they have been approved.

Institute of Public Works Engineering Australia

IPWEA connects, informs, represents, and leads public works professionals in Australia who are striving to manage their infrastructure assets effectively even as funding for infrastructure becomes more constrained. In fact, IPWEA estimates that 50 years ago local governments spent nearly 50 percent of their funding on road projects. Today, that amount is estimated at 25 percent because of other funding demands on local agencies.

A strong, consistent national framework for asset management in Australia's local agencies emphasizes three key elements to developing sustainable communities:

- Stewardship and the role of elected officials as stewards of public funds
- Managing existing and new assets with asset management plans
- Focusing on long-term financial planning as an essential part of doing business

An important emphasis is on maintaining the infrastructure and the financial capital over the long term, and IPWEA provides tools and templates to help local agencies in Australia meet this objective. Key components to this management strategy are illustrated in figure 5 (see next page). They include the following:

- An asset management plan that describes the services required, how the services will be provided, and the funds required to provide the targeted level of service over a 3- to 4-year period
- A long-term financial plan that describes how services will be funded over a 10-year period

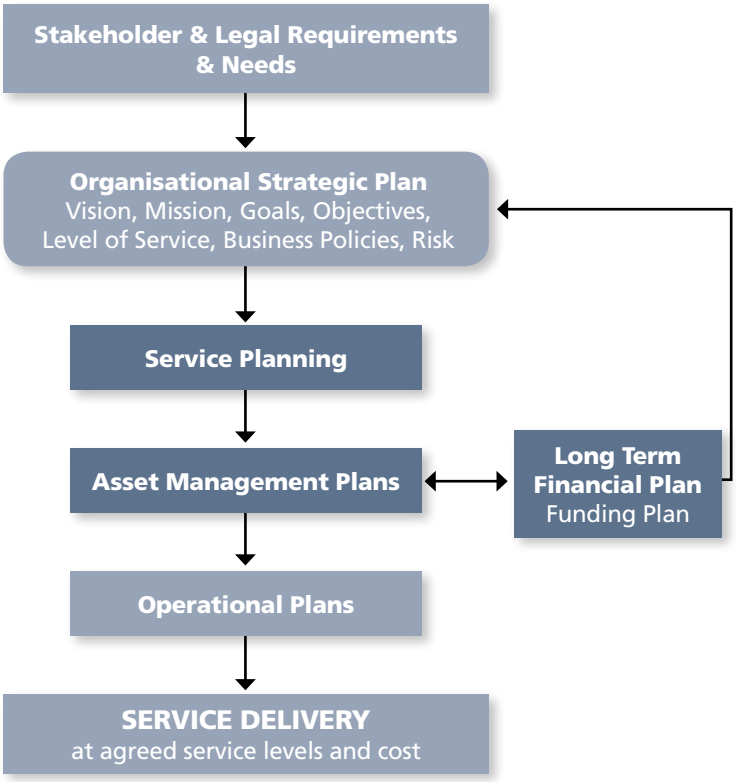

Figure 5. *Role of the long-term financial plan (IPWEA).*

These documents are directly linked to the agency's strategic plan and operational plans so that strategic, investment, and program decisions are all aligned.

Three of the six states in Australia have legislated the use of long-term financial plans in local agencies to establish the necessary link between funding requirements and the levels of service outlined in an agency's asset management plan. The financial plans consider the whole-of-life costs associated with the maintenance and renewal of a road, which include initial, operating, maintenance and renewal, and disposal costs. As a result, agencies have moved from a focus on annual budgets to long-term financial plans that link service levels with funding requirements. New South Wales, for example, develops a 10-year strategic plan with a 4-year management plan containing four annual budgets. The plan must be approved before the local agency has access to the first year's budget, and once the plan is approved, it cannot be changed without community input. New South Wales also has a requirement that a long-term financial plan be in place before it can request increases in property tax rates. Once the long-term financial plans are developed, they are audited regularly to evaluate whether the local agency actually implemented what it said it would with the funds, which has helped stabilize road improvement programs. IPWEA reports that the long-term financial plan is key to advancing the philosophy of asset management and providing a sustainable and viable approach for maintaining road assets.

The long-term financial plans help agencies focus more on the long-term sustainability of the services provided and development of strategies for managing (not just funding) the gap between actual and desired funding levels. As a result, agencies better understand the impact of new assets added to the network and the resulting lower levels of service that may be provided if funding for maintaining those assets is not incorporated into the financial plan.

IPWEA's *Australian Infrastructure Financial Management Guidelines* document includes a comprehensive summary of how to account for infrastructure assets, as illustrated in figure 6. The guide recommends several financial sustainability metrics for local agencies to use. One metric is the asset sustainability ratio, which is the ratio of expenditures on asset replacement to annual depreciation expenses. This ratio helps an agency determine whether its assets are being replaced or renewed at the same rate as they are deteriorating. This ratio is used by local authority councils in Australia that are required to establish levels of road renewal to keep pace with the rate at which roads deteriorate. The councils must fund the depreciation fully or explain to the communities why they are not providing adequate funding. This practice keeps the attention of elected officials on the deterioration of the road network and the funds required for its ongoing maintenance and renewal. IPWEA provides free training to elected officials that explains long-term financial planning and emphasizes their role as stewards of public funds.

Transport for London

Asset management has been successfully integrated into the day-to-day practices at Transport for London since a focus on managing assets effectively was established in the 1960s. Key contributors to the success of its asset management program have been senior management support and management recognition that asset management provides a program that will enable the agency to meet its objectives. The agency has been able to show improvements in performance each year, and it has broken down organizational silos so it could develop common asset management objectives across assets and modes. Agency representatives have successfully communicated the impact of funding limitations on network condition and demonstrated that they have slowed the rate of deterioration by using the money wisely. As a result,

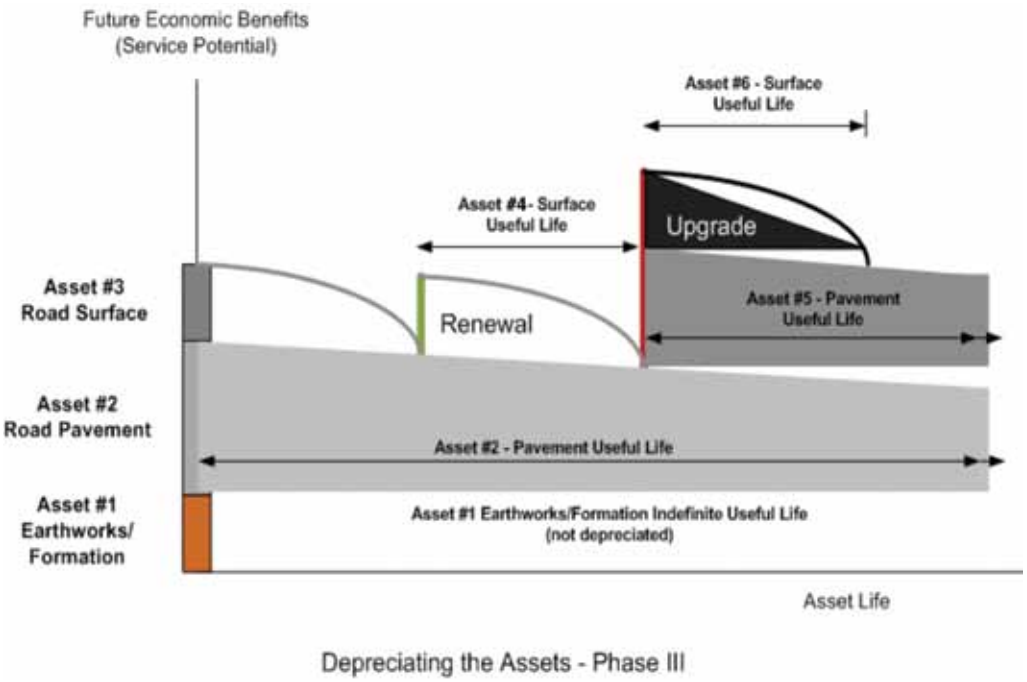

Figure 6. *Illustration of methods of accounting for pavement assets by component (IPWEA).*

senior leaders understand that slowing the rate of deterioration is a key to building a sustainable program when budgets are constrained.

A high-level framework was developed to describe how Transport for London will achieve the outcomes the mayor defined in his transport strategy. The framework includes two components, as shown in figure 7 (see next page): a business management section and a highways asset management section. The 10-year business plan presents the total investment that will be made over the period. Money can be moved from one year to another to address fluctuations in needs or special considerations that arise. For example, no road projects were scheduled for 2012, when the Olympics were held in London. Therefore, Transport for London accelerated some projects into 2011 to use the 2012 funding. The long-term business plan has helped the agency focus on long-term needs, improved efficiency, and provided a greater degree of certainty to the agency's modeling and forecasting.

The asset management component of the framework defines the targeted levels of service as part of the life-cycle strategies and asset investment plan activities. The capital and operational maintenance programs identify where the money should be spent and the performance monitoring activities measure the value achieved for the money spent. With this framework in place, Transport for London has been able to evaluate the impacts of different investment strategies, demonstrate the reliability of its predictions, put forward strong evidence-based arguments for maintaining appropriate investment levels, and defend budgets during financial crises.

New Zealand Transport Agency

New Zealand road managers embarked on their asset management journey in early 1992, leading to publication of the first *National Infrastructure Management Manual* in 1995. Subsequent legislation made road-controlling authorities responsible for prudent stewardship of transport assets supported by robust asset management plans. These plans were required to integrate the service delivery functions within the asset management planning framework. As part of this process, all roads were reclassified by their function rather than the traffic levels they carry. Each road category has different performance standards that reflect the impact of the road on the country's economy.

One of the challenges NZTA faced in implementing its strategic goals was that staff members tended to treat urgent issues that arose, which pulled them away from longer term strategic initiatives. To manage its culture and keep a focus on strategic priorities, NZTA separated job responsibilities so that one position focuses on strategic initiatives while another focuses on urgent issues. In dealings with the NZTA board and elected officials, asset managers strive to ensure that the focus is on strategic issues rather than detailed delivery and outcomes rather than outputs. An excerpt from

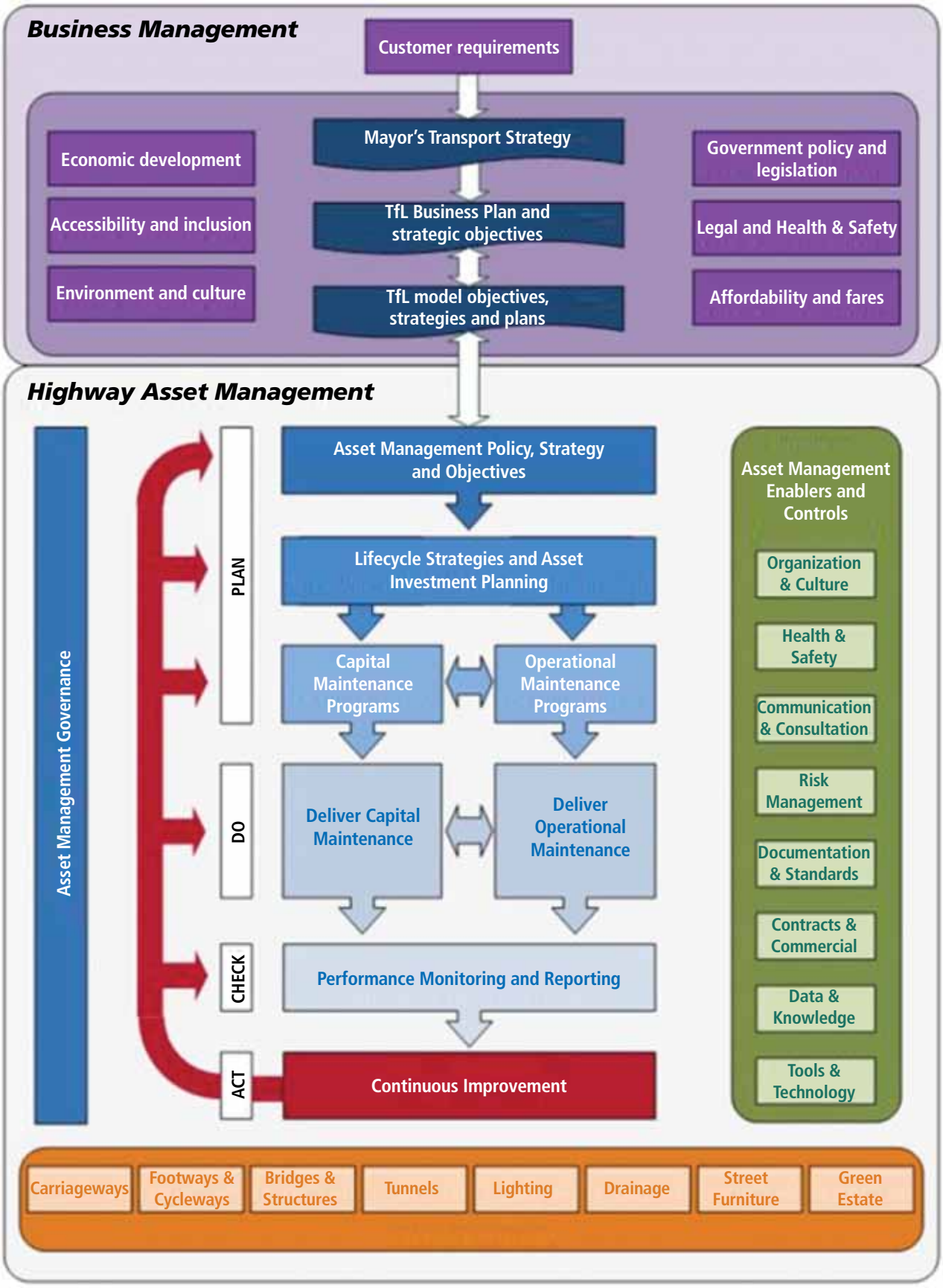

Figure *7. Transport for London's framework.*

the NZTA strategic plan, showing the specific priorities, policies, and strategies that will lead to an improved transport system in New Zealand, is in figure 8. Included in the strategic plan is a focus on seven key state highway routes designated as roads of national significance that will be constructed within the next 10 years. The roads are in New Zealand's five largest population centers, and the focus is on moving people and freight efficiently and safely within and between these centers.

There is a tremendous emphasis on outcomes and delivery efficiency at NZTA. Both internal and external audits are conducted regularly to evaluate the performance of different aspects of transport. The most significant audit in recent times was the 2009–2010 audit conducted by the government's auditor general. The first part of this audit looked at the adequacy of the asset data and the second part looked at how the asset was actually managed. These audits reinforced the notion that good asset management decisions must be evidence-based.

Following the completion of the audit, NZTA was instructed to get better information to manage its assets, and it was given a year to address the issue. The government auditor indicated that the following information was needed to enable asset management:

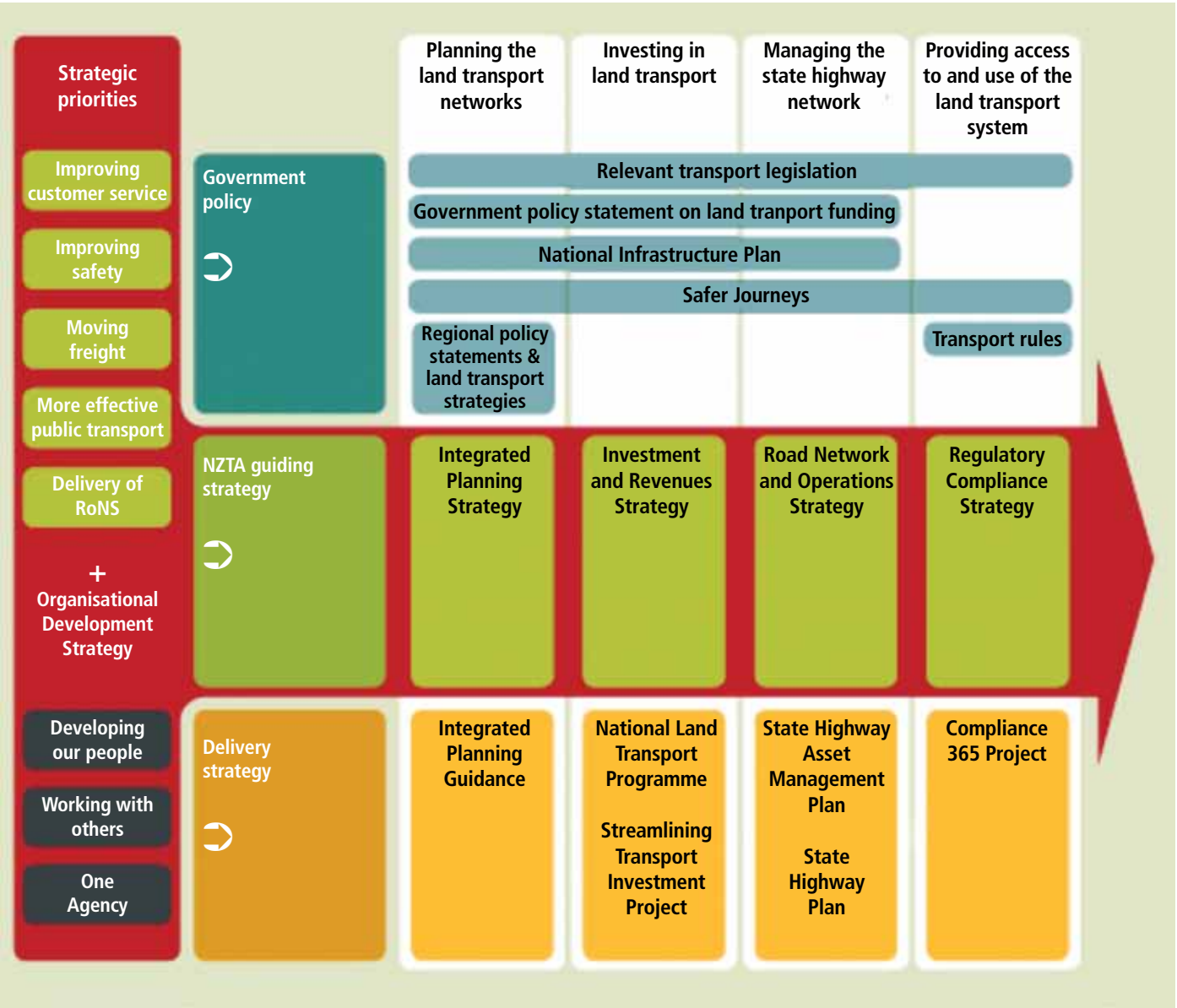

Figure 8. *Strategic plan for building a better land transport system in New Zealand (NZTA[14]).*

[14]New Zealand Transport Agency (2010). *Our Strategic Direction 2010–2013.* New Zealand Transport Agency, Wellington, New Zealand.

- Pavement condition
- Remaining life
- A replacement strategy
- Value of the pavement
- Available and needed funding

The bulk of the funding for maintenance and operations and improvements comes from road user charges and fuel excise taxes. In setting 3-year programs, the NZTA board needs to take note of the government's direction, signaled in the Government Policy Statement, and the demands of customers to maintain or enhance service levels. In light of the largely static revenue and increasing demands, the board accepted that the maintenance and operation levels of service were appropriate, but set an expectation of reducing the real cost of meeting them by 2 percent per year in the last 3-year program. In addition, it capped the next 3-year expenditure at the 2011–2012 level. As a result, the agency is evaluating tradeoffs between investments in safety and efficiency, and it is moving toward an optimization model that allows it to pick projects that match either investment priority. As it becomes more proficient with this modeling approach, NZTA intends to add a probabilistic model to evaluate likelihood of failure and better estimate risk exposure.

VicRoads

As in many other agencies, economic pressures are forcing VicRoads to be more efficient in providing services. Agency personnel quickly realized they could not keep doing things as they had in the past because the funding needed was no longer available.

At VicRoads, the improvement program is developed through a two-step process. The first step is to establish broad parameters on the number of kilometers that need to be addressed in each region based on pavement condition information collected on a statewide basis. For example, the guidance provided to the regions might indicate that 7 percent of the sprayed-seal network and 6 percent of the asphalt network need to be addressed. The seven regions, each of which manages about 4,000 km of roads, are responsible for selecting the projects that meet these parameters based on local knowledge of the road network and guidance provided by VicRoads. The current pavement management model, called Stitch in Time, is to intervene when a road has a minor defect to keep the road safe, but also to prevent the defect from becoming more expensive to repair. As a result, maintenance contractors are assessed a penalty if a defect is more than 100 square feet before it is repaired. Routine maintenance is funded first, so current funding limitations have greatly reduced the amount of restoration work done. VicRoads personnel conducted an analysis of their road network needs and determined that their primary focus is the low-volume sprayed-seal rural road network because its deterioration would be more catastrophic and cost-prohibitive to repair than the robust asphalt network in the urban area. Because the rural arterial road network is primarily an unbound system with a chip seal surface, treatments are designed to keep moisture out of the system. As a result of this strategy, the agency is allowing some deterioration to the asphalt road network and using funds that would have gone to that network to address more rural arterial roads. An example of a sealed road is shown in figure 9.

One of the primary challenges VicRoads faces is convincing the government to provide adequate levels of funding to address the agency's needs. Because VicRoads competes with other government services—such as education, health, and police—efforts are underway to improve strategies for

Figure 9. *Example of a two-coat seal (VicRoads[15]).*

[15]VicRoads (2004). *Bituminous Sprayed Surfacing Manual.* Technical Bulletin 45. Vic Roads, Melbourne, Australia.

communicating its needs to the Treasury and other stakeholder groups. Although in the past primarily pavement condition information was used, there is an increased focus on linking the level of service being provided to the impact on the community. Therefore, performance measures that link stewardship, availability, condition, and safety are being developed.

Officials indicated that the organizational culture features healthy competition between the regions. Regional personnel are allowed to implement innovative solutions as long as they focus on improving operations. Regular meetings provide opportunities to compare practices across regions and promote this spirit of competition.

South Australia Department of Planning, Transport and Infrastructure

The department's *Strategic Infrastructure Plan for South Australia*[16] identifies priorities for allocating resources to maintain and improve assets. The department's goals for asset management include the following:

- Clearly defined objectives and a link to the business plan
- Clearly defined levels of service
- Well-integrated risk management
- A good asset register
- Clear accountabilities and responsibilities

The agency is working on establishing level-of-service targets and linking them to corporate objectives. It is also working on establishing minimum levels of service for different road classifications. Its experience has been strong in the traditional areas of managing marine, pavement, and bridge assets, but the department is less mature in its ability to apply asset management principles to other areas. It is also working on being more explicit about considering risk in its asset management plans and identifying organizational changes necessary to support asset management.

About 3.5 percent of the rural road surfaces are replaced each year, which equates to a 30-year replacement cycle. Because an optimal replacement cycle would be closer to 12 years, the department is aware that its program is suboptimal and not sustainable in the long run. The department is using the lack of a sustainable program as an argument for additional funding for transport.

Periodic maintenance funds are distributed based on network type and equity between urban and rural roads. The equity component is considered important for keeping the rural road network at a minimum condition standard. The central office develops the 10-year optimized program based on an analysis of benefits over a 20-year period. It considers minimizing user costs and maximizing pavement condition as the basis for optimizing expenditures. The regions develop the 3-year short-term program, which considers pavement management recommendations as well as field priorities not considered in the software.

Highways Agency

The Highways Agency in England is dealing with a budget deficit, so agency is focusing on driving down the cost of government and the services it provides as well as improving the transparency of government activities by making massive amounts of information available to the public. As a result, the agency's aim is safe roads, reliable journeys, and informed travelers. Asset management allows the agency to take a long-term strategic approach to managing and monitoring asset performance. It uses an integrated approach that allows it to manage risk while focusing on the following:

- Whole-life cost
- Performance tools to monitor and drive delivery of operational outputs and outcomes
- Optimized maintenance scheduling and works to ensure best value
- Modeling tools to plan and justify strategic investment
- A single repository for asset information with unified standard and comparable measures for condition, degradation, and geographic locations

The whole-life cost principles are important to the Highways Agency for maintaining its network. These principles adhere to the philosophy of applying the right treatment at the right time and procuring services that maximize the whole-life value of an asset. One of the keys to the agency's application of these principles is the 4-year funding assurance that allows the agency a degree of confidence in its ability to fund projects when they will be needed. The whole-life principles are commonly applied to the maintenance and operation of assets in four focus areas: pavements, drainage, earthworks, and structures.

[16] Department of Planning, Transport, and Infrastructure (2005). *Strategic Infrastructure Plan for SA 2004/5–2014/5.* Department of Planning, Transport, and Infrastructure, Adelaide, South Australia.

A whole-life appraisal at the network level entails a review of spending plans across assets, which is linked to a whole-life appraisal at the scheme level and the programming level. This relationship is reflected in figures 10 and 11. Figure 10 shows a network-level spending plan, while figure 11 shows more detail on the planned expenditures on pavements. In both figures, the size of the bubble reflects the magnitude of spending in that particular area.

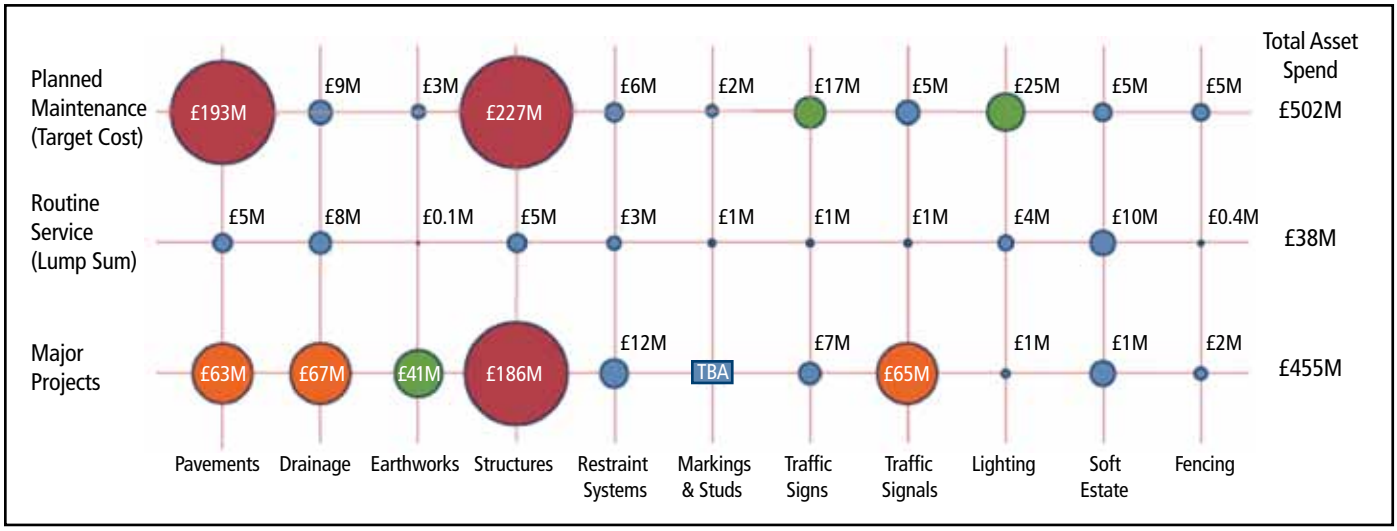

Figure 10. *Spending opportunities for the Highways Agency (England).*

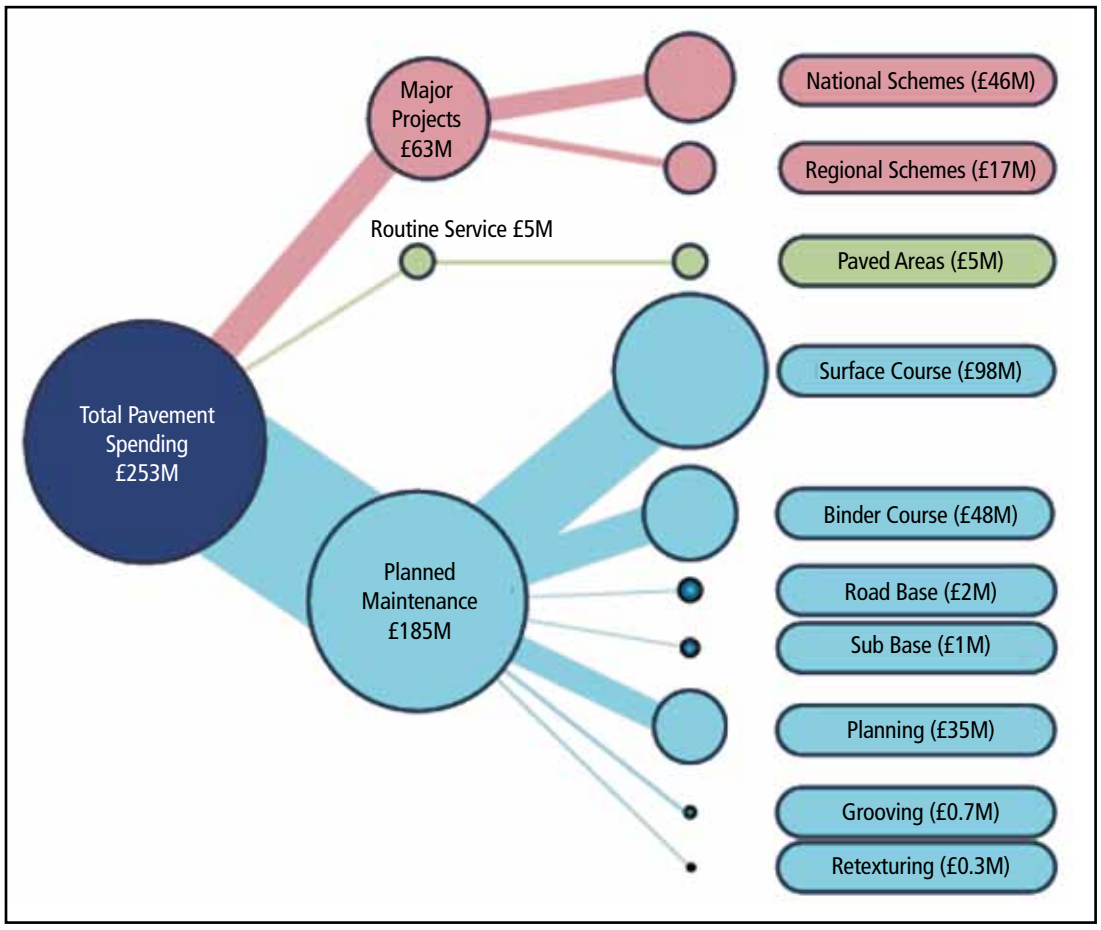

Figure 11. *Highways Agency (England) spending opportunities on pavements.*

Whole-life concepts are also considered in major projects in which the value of money is taken into account in partnership with the project's contribution to parameters such as health and safety. The agency is working toward development of analysis tools that will facilitate this type of analysis.

Transport Scotland

"Value for money" is a common policy theme for the U.K. Highways Agency, Transport for London, and Transport Scotland. Transport Scotland has a strong culture that supports making the best use of public funds. Therefore, customer views, which focus on road conditions, are important to the agency. Independent performance audits are an important check to ensure that the government gets the best value possible for the money it spends. For example, a 2010 road maintenance audit found that the use of asset management plans provided a strong business case for road programs, but transport funding decreases were causing Transport Scotland to build up maintenance needs and costs that future generations would incur. As a result, there is stronger pressure on the government to provide increased funding for the agency.

Transport Scotland recently developed a new Value Management Scoring Framework that considers safety, journey time reliability, environmental sustainability, value for money, and quality of submissions, with value for money rated as the highest factor. The scores from the value management process are compared to the condition information from the management system to determine the highest priorities. Value engineering is used for major projects, focusing on both internal and external factors that might influence a project. It provides decisionmakers with a sound basis for making decisions and results in decisions that are objective, transparent, consistent, and auditable. Officials report that the focus on value for money has driven down costs by 15 to 20 percent in the past year.

Finnish Transport Agency

The Finnish Transport Agency initiated pavement management efforts in the mid-1980s, when the agency realized that it would have less funding to manage the road network. The pavement management champions convinced individuals at the top of the organization that the agency needed a systematic process for road maintenance. Once they had secured support from the top of the organization, it was easier for them to get their ideas implemented throughout the organization. They started by collecting pavement condition information and have since implemented network-level pavement management software.

Initially, the agency's efforts at developing a systematic method of managing the road network met resistance from regional offices, which were concerned about losing their autonomy. However, the central office recognized the importance of a performance-based approach and selected the performance measures that would be used to manage the network. At first, performance targets were set annually, which led to some short-term decisions by the regions. The agency has since moved away from annual performance targets to 4-year performance targets, which has helped regions shift toward longer term solutions. Regions that are not satisfied with how funding is allocated continue to challenge the performance-based culture, and at times political pressures lead to a less-than-optimal distribution of funding. The agency, however, considers pavement management a big part of its investment decision process and the basis for making good decisions. In the future, the agency would like to have models that consider safety, user costs, environment, and comfort for managing the road network. It would also like to be better positioned to address corridor needs that consider both pavement and bridge investment needs.

The focus on longer-term strategies can be seen in the investment strategies top management has established. For instance, management has instituted programs that prioritize maintenance of the road network, even at the expense of new investments. As a result, money has been invested in developing condition measurements, management systems, and related applied research activities. Road condition was included in the agency's management-by-objectives approach, which forced regions to improve their pavement management practices.

Rijkswaterstaat

Asset management is fully integrated into the culture of the Road Traffic and Transport Authority, part of Rijkswaterstaat in the Netherlands, as demonstrated by the director general's comment that "asset management is about your culture and the way you think" more than the technical analysis of the data. Support for asset management is evident at the top of government, where management considers the ability to predict what it has key to making the organization work the way it wants it to. Therefore, asset management has been critical to the implementation of the government's policy and agency commitment to exploring new opportunities to enhance system performance. Asset management is so strongly integrated into the culture that it has been branded using a yellow line as a symbol that connects pavement management, bridge management, traffic equipment, and people. The yellow line appears on all asset management materials and is featured prominently in the asset management office, as shown in figure 12.

Figure 12. *Yellow line used to brand asset managment in the Netherlands.*

The agency has a formal strategic framework for asset management that helps align and focus the organization. The framework balances three components: costs, performance, and risk. Asset management provides the organization with the knowledge needed to balance a program between acceptable risks and budget and performance expectations. Therefore, the agency analyzes and optimizes these factors while striving to meet customer demands within budget constraints and organizational needs. Once a program is agreed to, a 4-year contract is signed with the secretary to formalize the service level that will be provided.

Key performance indicators (KPIs) for the agency are based on the RAMS-SHEEP model, which includes the following:

- **R**eliability
- **A**vailability
- **M**aintainability
- **S**afety
- **S**ecurity
- **H**ealth
- **E**nvironment
- **E**conomics
- **P**olitics

The RAMS indicators are the technical performance measures and the SHEEP indicators address other societal and stakeholder interests.

A fundamental principle behind the operation of Rijkswaterstaat is that the technical quality of the work influences the durability of the asset. Therefore, at the highest level of the organization the expectation is that the technical staff will safeguard the quality of the work to achieve a long service life with less maintenance, less traffic disturbance, fewer materials, and a smaller carbon footprint. Therefore, asset management needs to project these needs and provide a line of communication with politicians about the costs required to address them. This has been a challenge in recent years as budgets have become tighter. However, the agency has developed stronger contracts that tighten specifications, consider quality in the procurement process, and require contractors to monitor and report on quality.

Swedish Transport Administration

Although the Swedish Transport Administration reports that it does not have an asset management model in place, it has a pavement management program that encourages treatment selection based on maximizing the overall effect of the available budget. Top-level support for the program is considered important, and the agency reports that there has been support for pavement management since at least 2002. Another important factor includes having the right information to support the appropriate level of quality for the road system. For example, at a strategic level, a "delivered quality" target is established in the long-term 10-year plan in terms of satisfied road users. At the tactical level, satisfied road user criteria are linked to targets defined in terms of condition variables, which are defined in the agency's maintenance standard and used to calculate the maintenance funding needed. This example illustrates the agency's efforts to link data used at various levels of the organization.

The Swedish Transport Administration reports that because of its systematic approach to managing the road network, the agency has been able to keep pavement conditions at constant levels, even with less money and increasing traffic levels. Other factors, such as improvements in road-building materials and the use of innovation, have undoubtedly contributed to the improvement in road conditions.

Norwegian Public Roads Administration

NPRA has used pavement management since the mid-1980s. Initially, the program focused on both user costs and socioeconomic factors, but the models were later modified because of the difficulty in modeling factors, such as crashes and delays. Pavement management rose through the organization from the bottom up, and decisionmakers had to be convinced that this was the way to go. To some degree, pavement management succeeded because the agency had good information on pavements that provided for systematic planning decisions. Regions and districts now use pavement management in developing their maintenance programs. In recent years, there has been increased interest in pavement management from the public, media, and politicians because of the maintenance backlog that has been reported.

In the past, preventive maintenance decisions were separate from other investment programming decisions. NPRA has moved toward a more holistic approach that includes integrated maintenance plans across asset types and a focus on transport corridors. Pavement maintenance and reinvestment funding is based largely on preventive maintenance needs from pavement management. Risk is not typically considered in pavement management, but may be assessed separately for crisis and emergency planning or bridge and tunnel assessment. One of the challenges pavement management faces is its ability to show the impact of deferred maintenance because it often takes several years for the impacts to be realized when roads are in relatively good condition. Maintenance trigger levels are set based on the results of an evaluation of life-cycle costs that considers both agency and user costs. A program focus is to reduce the maintenance backlog.

Danish Road Directorate

Pavement management was introduced in the Danish Road Directorate in 1983 after some bridge mishaps encouraged the agency to think about monitoring asset conditions and making more efficient use of finances. Before the use of pavement management, the regions were responsible for maintenance and rehabilitation of the road network. They resisted the new way of doing business because they perceived it as a loss of authority over project selection. Over time, the agency has been able to overcome the regions' resistance. The agency's pavement management practices received a major boost in credibility in 2010 when an external study recommended investment allocations that closely matched the recommendations issued by pavement management. The allocation is based on user costs, the estimated life remaining in a pavement, the amount of degradation due to traffic, structural capacity, and pavement damage. A benefit-cost analysis is used to optimize the feasible solutions, which include three scenarios: minimum maintenance for safety only, steady-state conditions, and removal of the backlog. Pavement management is now considered an important source of information for making effective decisions.

Institute for Transport Sciences

As discussed in chapter 2, the focus in Hungary has been on developing the motorway. Investment levels in the remainder of the network have not been adequate to offset network deterioration of pavements and bridges. However, efforts are underway to communicate the advantages of maintaining the network from a whole-life perspective. For instance, the principles of lifetime engineering, which were initially created in Finland for building maintenance, have been introduced. The principles of lifetime engineering focus on the design of an asset over its entire life, including end-of-life strategies and modular design. The modular design concept is similar to an automobile maintenance guide that indicates what should be done at different points of the car's life. These types of ideas are being introduced to various stakeholders in Hungary in an attempt to ensure that available information is used wisely to support a long-term focus on asset maintenance.

Chapter 4. Agencies Help Elected and Appointed Officials Be Better Stewards of Transportation Assets

In some of the countries visited, especially Australia, use of long-term financial plans was strong at the local level. 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 how 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.

Several of the agencies the scan team met with indicated that 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 regularly for funding.

This chapter provides examples of how agencies monitor the use of public funds and how elected officials have been trained in their responsibilities as fiscal stewards.

Institute of Public Works Engineering Australia

One of the catalysts to the use of asset management, long-term financial plans, and good stewardship in Australia was the work of IPWEA to establish the necessary framework, tools, and drivers. As discussed in the previous chapter, the legislated use of long-term financial plans by local governments in Australia helped foster the responsible planning and management of resources among elected and appointed officials by providing information about liabilities for unfunded road maintenance and renewal activities. Through IPWEA training, elected and appointed officials better understand their responsibilities to provide funding for these unfunded liabilities or account for the deficiency in some other way. As a result, Australian public officials focus on maintaining the value of the road network through road preservation and enhancement activities. The emphasis on long-term financial planning is further supported by regular performance audits to ensure that government agencies are following their plans. While the legislation to use long-term financial plans increased the focus on financial sustainability, the audit component holds elected officials accountable for implementing the plans. IPWEA's free training courses for public officials support these efforts through their focus on stewardship and fiscal accountability.

Highways Agency

In the countries the scan team visited, as in the United States, the window of interest for elected officials does not coincide with a transport agency's desire to operate and maintain the network for the lowest whole-life cost. In England, the reviews conducted by the Independent Public Accounts Committee of Parliament and the Transport Committee of the House of Commons have been instrumental in building support and trust for Highways Agency programs. The Highways Agency is somewhat protected by the fact that political decisions also go through the Independent Public Accounts Committee, so any deviations from plans are investigated. The agency considers the national audit a powerful tool, and politicians usually heed the audit findings. The Highways Agency indicates that politicians want to know the agency has good ideas on the long-term management of the transport assets and that policies are in place and followed so the Treasury does not have to interfere in agency management and operations. The audits have helped establish that degree of confidence in the Highways Agency among elected officials.

Transport Scotland

A recent road audit on road maintenance for Transport Scotland indicated that the agency was building up future maintenance needs and costs for future generations, prompting government action to address the problem. Transport Scotland reports that independent commissions help expose government actions that a government agency might not easily be able to report externally.

New Zealand Transport Agency

NZTA representatives believe that elected officials support road preservation activities because it has been an important part of the culture ever since the country was established. NZTA is working with a set revenue stream that is largely static and does not quite match cost increases. Therefore, tradeoffs are an essential feature of programs, and the agency works hard to present the consequences of the tradeoffs to both the NZTA board and elected officials. There is a strong link between outcomes and investments in NZTA programs. Customer input is part of the process, and NZTA has developed a customer filter that helps it relate customer opinions to the level-of-service targets.

Financial reports include the cost of future renewals, so elected officials and other stakeholders can clearly evaluate whether renewals are keeping up with deterioration. Local agencies that do not provide adequate funding to offset the depreciation expense must explain why they are not providing enough funding. As a result, council members must be upfront about dealing with asset deterioration. To date, the rate of deterioration has primarily been funded in full, but council members are concerned that the level of service being provided is too high.

VicRoads

At VicRoads, maintenance costs for capital projects over the next 30 years are incorporated into the calculation of whole-life costs when financing new projects. These maintenance funds are placed in the general maintenance fund, although they are not tied to a particular project. Even though the availability of these funds for a particular project is not assured under this method, the process at least provides a means of ensuring that future maintenance costs are taken into consideration when capital projects are funded.

Swedish Transport Administration and Finnish Transport Agency

In general, the Nordic countries that participated in the scan did not demonstrate the same level of support from elected officials as other countries included in the scan. However, three of the four agencies reported that they face severely constrained budgets and discussed methods of communicating needs with elected officials. Sweden has had a debate in the media about railroad maintenance, and the Swedish Transport Administration has observed a shift in funding from pavements to railroads. In response, the agency is determining how to manage the funding to best demonstrate the impact of the reduction. One possibility is to let some roads deteriorate to a point at which media attention will shift to the road network. The Finnish Transport Agency is experiencing a similar situation, so the agency is shifting funds for the local road network to other parts of the network so politicians will see the impact. If, on the other hand, budget cuts are applied to several programs, the agencies believe it takes too long for the impacts to be observed.

Chapter 5. Agencies Focus on Outcomes and Operate as Service Providers

The agencies that participated in the scan are moving toward a service-based rather than condition-based approach to managing their road networks. 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. The change has influenced the types of data collected and the performance targets used to drive the maintenance and renewal program. NZTA compared the philosophy to managing a utility. Under the 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. As described in this chapter, Rijkswaterstaat bases decisions on key performance indicators that focus almost entirely on service-oriented metrics.

Figure *13. The three-legged stool used by Transport for London.*

Transport for London considers risk, customer satisfaction, and cost as the three factors it must balance to provide an acceptable level of service, as shown in figure 13. The relationship among these factors and the point at which a zone is established for making investment decisions differs based on the asset being investigated. For example, because most highway users are less aware of bridge conditions than road conditions, risk and whole-life costs are the key decision drivers for bridges 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. These and other examples of how this shift has impacted programs are provided in this chapter.

New Zealand Transport Agency

As part of its efforts to put customers first, NZTA recognized that it needed to change the way it does business. This forced the agency to look to a service provider concept for transport that is similar to the telephone industry model. Under that model, customers do not care how big the phone wires are; they just expect them to be there in working order. This was a new way of thinking about service for NZTA that is now an integral part of how it does business. As a result of this service focus, the agency has moved away from a condition-based approach to managing the road network and prioritized managing the risk associated with deterioration of the low-volume network and providing a high level of service on major truck routes.

As part of this new business approach, the agency had to understand who its customers were and what drives their opinions. The agency established a Customer First Program that includes activities for getting feedback, building capability, and transforming the business. As one strategy for identifying service gaps between customer expectations and service levels, NZTA used qualitative and quantitative methods to identify customer values on performance and importance, as shown in figure 14. Low-performance, high-importance areas were identified as the areas where the biggest impact on customer service could be made. As a result, strategic priorities such as improving travel time, trip predictability, and freight efficiency were identified. Recognizing that funding constraints exist, NZTA places a priority on value-for-money outcomes that focus on developing the best possible work program that targets the most important

issues using the best possible solutions. In figure 14, the blue circles in the bottom right quadrant represent the areas that customers identified as very important and in need of improvement.

Another issue NZTA faced as it moved forward with its service-oriented approach is that staff members tend to focus on urgent needs at the cost of long-term strategic needs. Therefore, NZTA maintains a central office asset management role that is dedicated to strategic needs, while regional office asset teams focus on compiling and delivering the program. Because of the importance the agency places on road safety, pavement skid and texture information is collected for the entire road network, and investigatory and intervention levels are set to trigger safety improvements.

Highways Agency

The Highways Agency publishes an annual report that sets out performance measures and accomplishments as documentation of public fund expenditures and accomplishments. In the past, government administrators were target focused, but the current government is more interested in demonstrating accountability than tracking accomplishments. As a result, the Highways Agency focuses on transparency and having information available to the public. Rather than use targets as measures of success, the Highways Agency relies more on feedback from stakeholders to determine the success of its programs. There are, of course, exceptions to this, with some targets still in place for social issues such as carbon emissions. The movement away from targets

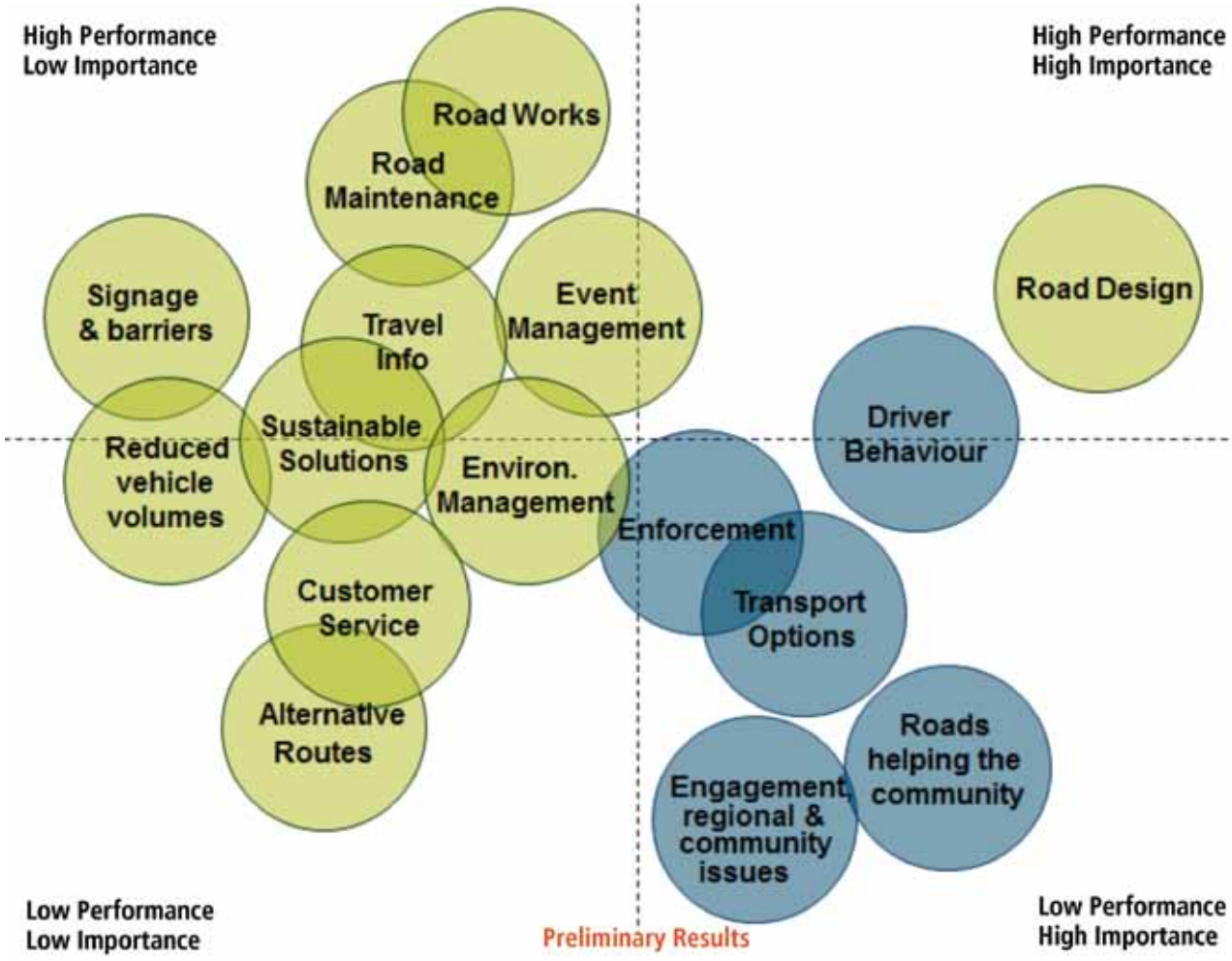

Figure 14. *Customer values identified by NZTA.*

occurred for several reasons. First, government found that targets do not necessarily have meaning for the public. The current approach allows the agency to report outcomes that have been achieved and the public can respond to those outcomes. Second, targets may set behaviors that do not necessarily correspond to good practice. For example, a hospital could achieve a target to reduce waiting time without necessarily providing appropriate treatment to a patient. Finally, the Highways Agency indicates that there was never a true connection to the targets set and the money it received. The agency reports that the new approach, which is based more on outcomes achieved than targets, improves negotiations with the Treasury because it can better explain what can be achieved with the level of funding provided.

As a result of its change in focus, the Highways Agency has modified its performance measures to be more customer-oriented. For example, the agency has established performance measures to improve the reliability of journey time, because customer surveys indicated that the traveling public is more interested in knowing how long the journey will take than travel speed. This has resulted in a change in philosophy because the organization had focused previously on travel speed.

The philosophy change has also changed how the network is managed. For instance, on some managed motorways the hard shoulder is used during times of high congestion to better manage traffic, allowing capacity to be added when it is needed. This has resulted in lower costs to the agency because it has not had to add another lane, and the solution is considered a green strategy. The Highways Agency reports that the strategy has improved travel time reliability without increasing crashes.

Rijkswaterstaat

The Road Traffic and Transport Authority in the Netherlands has a public-oriented approach to managing its road network that focuses on minimizing interruptions and accelerating contractor program execution through incentives. The agency also bases its KPIs on a model that focuses on both technical and nontechnical factors. It is referred to as the RAMS-SHEEP model, with RAMS representing technical considerations such as reliability, availability, maintainability, and safety, and SHEEP representing the soft side of the decision process, which includes security, health, environment, economics, and politics. The KPIs help the organization address its highest priorities when resources are constrained.

The agency's efforts to move toward more sustainable solutions have increased its focus on energy use and green energy, green procurement methods, and sustainable area development. For example, the Netherlands has national minimum criteria for sustainability, and contractors are challenged to develop sustainable solutions that reduce energy use and carbon dioxide emissions. Because of the importance of this issue to the country, these initiatives are being supported even though they have led to increased contract costs.

Noise is another priority issue the agency has had to address. It has considered several options, including building noise walls and changing the pavement surface. Because noise walls are about 10 times more expensive than the pavement surfacing option, the agency has increased its use of open-graded friction courses on the network.

Another example of the service-oriented nature of the Road Traffic and Transport Authority is its use of service-level agreements (SLAs) between the asset owner and the asset manager. In the past, SLAs were based primarily on pavement condition indicators, but the agency is developing new metrics for highway availability and reliability that better dovetail with higher level policy issues. SLAs are made for 4 years and include the related financial plan based on a long-term financial forecast. The new metrics for road availability consider the amount of time the road is open to the user with minimum traffic speeds of 40 miles per hour (64 kilometers per hour). The agency envisions establishing different availability targets based on road category. For instance, the highest level road system might have an availability target of 95 percent.

VicRoads

For years, VicRoads relied on traditional performance measures, such as the International Roughness Index, to monitor the performance of the road network. However, the Treasury is not interested in information on the physical condition of the road, so VicRoads is working on developing improved performance measures that better link road conditions and user needs while answering the question of "what service do we provide?" As a result, the agency is increasingly focused on the level of service being provided in five community focus areas: safety, reliability of travel, comfort, roughness, and livability.

Transport for London

Transport for London considers risk, customer satisfaction, and cost the three factors it must take into account to provide an acceptable level of service. 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. Figure 15 (see next page) illustrates the relationship between customer

satisfaction, risk, and whole-life costs and state of good repair for bridges. 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 the right 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.

Transport Scotland

Transport Scotland began conducting customer surveys in 2007 to determine road user priorities and has conducted the surveys annually since then. Initial data trends show that public satisfaction in the network is dropping as budget levels drop. Therefore, Transport Scotland has made it a priority to establish targets that will maintain customer satisfaction by investing heavily in user priorities.

The public surveys involved face-to-face interviews with about 1,000 residents in each of two waves to see if seasonal variations affected the results. The participants represent a statistically sound sample of the population based on factors such as location, age, road use, and so on. The results showed that about 41 percent of the participants had encountered unsafe road defects, with potholes identified as the main defect they encountered. The survey also found that more than half of the respondents were dissatisfied with the rate at which road defects are repaired and a similar number indicated that they were dissatisfied with the quality of the repairs. On the other hand, the majority of participants were more satisfied with winter maintenance activities performed by Transport Scotland.

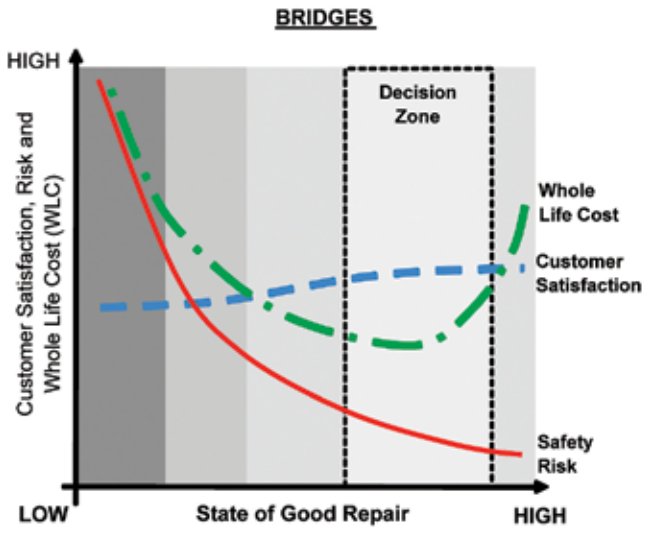

Figure 15. *Consideration of multiple factors influencing the state of good repair for bridges at Transport for London.*

Customer feedback is proposed as a component to consider in the revised performance management framework for monitoring and reporting performance. The proposed approach links the results of the customer survey directly to Transport Scotland's corporate and business plans. The information has also been used to develop level-of-service criteria. Twenty-seven criteria have been identified, covering factors such as network condition, road works, winter maintenance, lighting, markings, and signs. Performance on each is rated excellent, good, fair, or poor and is linked to the asset management models to identify and justify planned expenditures.

Finnish Transport Agency

The Finnish Transport Agency conducts road user satisfaction surveys each winter and every other summer. Focus groups are also used to identify problem areas and convey maintenance strategies. The agency has also formed a panel of frequent drivers who record driving conditions using Global Positioning System technology. In addition, the agency receives feedback from road users through telephone, e-mail, Internet, and the media. The information is used as background for developing maintenance strategies, and small problems that are identified are solved as soon as possible. Because of the importance the agency places on addressing customer needs, it has established a director's slot that focuses exclusively on stakeholder relations.

Norwegian Public Roads Administration

The priority NPRA places on customer service and the societal impact of roads is evident in its vision statement: "On the road to a better society." This priority can be a challenge to the agency because customer expectations continue to increase and customers are less tolerant of disturbances and unexpected events that impact travel time and safety. Important economic considerations also must be taken into account in Norway. For example, the fishing industry cannot tolerate a 2-day road closure because the fish must be thrown away if they spoil before getting to market.

Swedish Transport Administration

The Swedish Transport Administration uses road user opinion surveys to evaluate customer needs. Although the agency reports that it can be difficult to link the survey results to pavement conditions, it acknowledges that the information has influenced budget levels positively. The results provide the agency with a general indication of the percentage of road users who are satisfied with the road network.

In addition to the road user opinion surveys, the agency has conducted focus groups that have found that eliminat-

ing pavement surface moisture is a high priority for the public. The agency also discovered that drivers do not like having to react to avoid pavement deficiencies such as potholes and that they associate patches with rough roads. Truck drivers were reported to dislike narrow roads with weak edges. To some degree, these results have been used to influence highway maintenance policies so they are more customer-oriented.

Danish Road Directorate

In the four Nordic countries that participated in the scan, the programs administered by the Danish Road Directorate are probably the least affected by input from user surveys. The agency uses an outside consultant to conduct road user surveys twice a year. The survey queries the public's satisfaction with the evenness of the road network. Feedback is also obtained from a phone hotline and mail. The information received is not directly incorporated into the decision process, but if there were big changes in the results, the agency believes the results would become a much more significant focus.

South Australia Department of Planning, Transport and Infrastructure

The changes that took place in the organization with outsourcing and economic constraints had a significant impact on the department. The agency was forced to specify what level of service it wanted to provide to the public and determine ways to measure that the level of service had been achieved. At the same time, the department focused more on ensuring that the funding it had received was being used as effectively as possible. This heightened focus helped improve stewardship and the services provided to the road user.

When asked about the degree to which the department's programs meet community objectives, agency personnel indicated that they consider risk the key to balancing investment strategies and community expectations with constrained funding. Decisions on expectations that cannot be met require qualitative decisions based on expected tradeoffs between investment classes. For example, the decision to replace either signals or guardrails is a challenge because both assets relate to safety issues.

Chapter 6. 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 agency 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 have placed the highest priority on maintaining and renewing the existing highway network rather than spending limited dollars on capital enhancements. In some cases, as in England's Highways Agency, opportunities for expansion are limited because of space constraints. This places even more importance on the Highway 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 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 example, 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 used by the participating agencies differed from those commonly used in the United States in some important ways. U.S. 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.

Highways Agency

As described earlier, the priorities of the Highways Agency are clearly spelled out in its strategic plan. Organizationally, the chief executive officer of the Highways Agency is responsible for ensuring that funds are used properly and reporting to Parliament the outcomes achieved for the funds spent. Agency priorities are agreed on by the secretary of state for transport. The top priority is the condition of the assets, the second priority is accessibility (e.g., traffic management), and the third priority is capital improvement (e.g., new construction). The secretary of state is aware that funding is not adequate to address all needs, but the Highways Agency must ensure that safety is not compromised.

Transport Scotland

Transport Scotland is in the third year of very tight budgets, and although public satisfaction has decreased, public expectations have not. The agency has a well-developed road asset management plan that sets objectives, targets, and required financial plans that communicate agency priorities. The plan supports the government's targets for improving efficiency, reducing casualties, and lessening the impacts of climate change.

Performance audits are an important part of the success of the road asset management plan to help ensure that the objectives are met and that funding is being used as intended. Transport Scotland programs are monitored and reported by the Performance Audit Group and reviewed and endorsed by Audit Scotland. One of the reports produced by the Performance Audit Group is shown in figure 16.

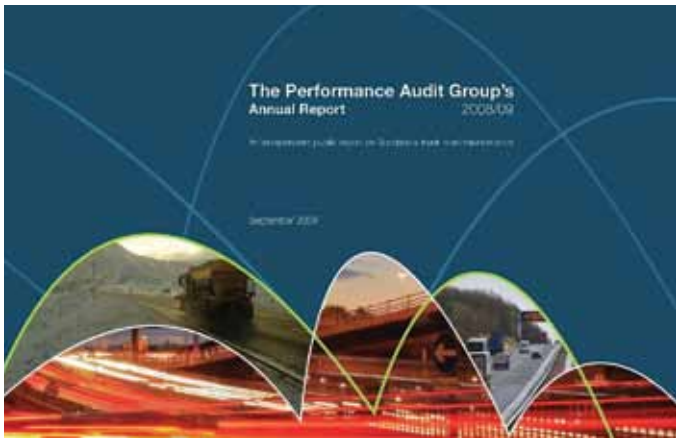

Figure 16. *Performance Audit Group Annual Report.*

Rijkswaterstaat

The Road Traffic and Transport Authority in the Netherlands considers asset management more of a culture and philosophy than a job title. Even so, the agency has clearly defined roles for all individuals involved in asset management. For instance, the asset owner is responsible for the future of the network, focusing on strategic issues associated with setting performance targets, risk levels, and investment levels. The asset manager is responsible for developing and implementing tactical plans for the established investment level that define the program and standards that will be met. Therefore, the asset manager is responsible for program management, risk management, and performance management. The service provider is responsible for operations—including asset renewal, expansion, and maintenance—in accordance with the tactical plans. The signed service-level agreements discussed in Chapter 3 establish a formal structure for establishing these responsibilities.

Initially, there was pushback from the regions that lost some autonomy in how the network would be managed. However, the director general made it clear that a performance-based asset management philosophy would be used and that there would be consequences if regions did not embrace the changes. Today, the management of the road network is considered to be very professional with contracts clearly specifying projects and expectations. Rewards are in place for managing the network well and achieving goals. As a result, system performance has improved. In addition, communication and cooperation among the various stakeholders are better.

VicRoads

At VicRoads, safety and network preservation are high priorities. Other priorities, such as reducing roughness and minimizing user costs, are being deferred until more funds become available. As a result of these priorities, the agency has sacrificed funding for the highest category of roads to fund resealing of the low-volume sprayed-seal rural roads to keep moisture out of the system and reduce the risk associated with deterioration of the rural arterial road network.

Employees are held accountable for making good decisions that use available funding efficiently. There are job descriptions for each position, and pay increases are based on the results of a formal assessment process that evaluates whether available funding has been spent and whether performance outcomes specified in a contract have been met. Management uses pavement condition improvement and coverage percentages to determine whether money has been used wisely. If goals are not met, management works with the employee to address performance issues that may impact the execution of the program. VicRoads also has achievement awards to recognize individuals who have brought about significant improvements.

Finnish Transport Agency

The road program priorities the Finnish Transport Agency follows are also well defined. The long-term strategies are aimed at maintaining the current condition of the main roads and letting the remainder of the system absorb the funding shortage.

The Finnish Transport Agency provides incentives to regional personnel for meeting condition targets, but the agency recognizes that it needs to improve its ability to track how regions have used the funding provided. A program is in place that provides merit pay increases of 2 to 3 percent on annual salaries to all workers in a region if performance targets are met. There has been some evidence that this program has resulted in the use of short-term treatments to achieve performance targets, but the improvements being implemented in tracking treatments are expected to eliminate this problem.

In addition to the regional bonuses, bonuses are incorporated into the performance-based maintenance contracts when an alternate, less-expensive treatment is used to good effect. In these instances, the contractor can receive up to two-thirds of the savings realized.

Swedish Transport Administration

Regional engineers at the Swedish Transport Administration are not held directly responsible for the quality of their program because so many other factors influence the final projects. Therefore, the agency places more emphasis on the use of data and open communication to achieve agency goals. This is still a relatively new concept for the agency, and it is investigating methods of holding an entire group responsible for the quality of the delivered program.

Norwegian Public Roads Administration

Although it provides no economic incentives for achieving performance targets, NPRA has a management-by-objectives philosophy that ensures regional managers understand and are contractually committed to reaching performance targets. No employees have lost their jobs for not meeting targets, but the potential exists for that to happen.

In addition, the agency has several maintenance contracts that include penalties and/or bonuses based on roughness targets. The agency has found that using incentives fosters

contractor innovation. The results are promoted among other regional contractors to promote improvements in other parts of the country.

Danish Road Directorate

To improve agency transparency, the Danish Road Directorate carefully tracks each pavement rehabilitation project to ensure it is managed effectively. Any deviations from the plan greater than 10 percent in cost must be explained to elected officials. In addition, the agency reports work quantities from the pavement management system and the final quantities of work performed as well as the expected and actual life extensions. Again, any deviations must be explained.

New Zealand Transport Authority

As discussed earlier, NZTA programs are subjected to both internal and external audits to reinforce the notion that good asset management decisions are evidence-based. Like many other agencies, NZTA prepares a statement of intent each year, based on statutory roles, and a letter of intent from the responsible government minister. The agency reports on the statement of intent each quarter. The annual report is presented and interrogated at the Parliamentary Select Committee level. In addition, asset condition measures such as roughness, rutting, texture, and skid resistance are measured network-wide each year and form part of the performance monitoring framework, together with commentary on whether the investment produced the expected outcome. These audits are generally considered positive activities (as opposed to audits focusing on waste and abuse) that have resulted in improved performance and value.

Chapter 7. Agencies Invest in Workforce Capacity Development and Succession Planning

The agencies that have successfully navigated a paradigm shift in the way they manage 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 management at Rijkswaterstaat discussed in Chapter 3. Participating agencies also have established prominent, well-respected asset manager positions.

In some cases, the participating agencies reported that when they began outsourcing maintenance activities, they lost too much organizational competency. Over time, as they have gained experience with contract maintenance, most of these agencies have worked to rebuild the skills of their workforce so they can become smart buyers of services from private industry. In at least one case, explained in Chapter 8, the agency established an internal provider that must compete with private industry so it can retain necessary skills and better understand the issues contractors deal with.

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 stakeholders, including executives and legislators, look to for information. This chapter presents examples of how agencies have invested in their internal capacity.

Rijkswaterstaat

Rijkswaterstaat's implementation strategy has transitioned from thinking to getting things done by making regional offices responsible for maintenance and renewal activities and the central office responsible for the development of appropriate standards and policies, all of which are done in partnership with agency stakeholders. The agency emphasizes moving things forward early rather than waiting until something is perfect. As a result, change occurs fairly rapidly and employees are encouraged to take controlled risks.

To foster this culture, the Rijkswaterstaat has created prominent positions for asset owners and asset managers and has implemented vertical learning courses on asset management. These courses recognize that each group in the agency needs different information and skills based on the group's job activities. To introduce agency personnel to asset management, a 1-day course is conducted for people at all levels of the organization. The 30 to 40 participants take part in role-playing in specific areas commonly involved in asset management, such as facilitation, cooperation with other groups, and mentoring. The training philosophy is that the participants will learn more by doing something than studying it. Training is a high priority for the agency because loss of technical knowledge can lead over time to diminished organizational capabilities and lower technical quality. The agency is addressing this problem by building a team of smart buyers who understand the value of asset management as a high priority for any transport agency to fulfill its duties. One agency strategy is improving contract terms to ensure quality. In the future, the agency may also require contractors to hire independent assessors if they are not able to internally replace the skills required to ensure quality.

Retaining organizational competency is a major agency focus, especially because a significant number of agency personnel are expected to retire in the next several years. As the organization has shifted to the use of contractors, the agency has had trouble attracting young engineers because they are more interested in building assets than maintaining them. The agency is considering supporting the development of a master's degree program that will train technical personnel to deal with risk and financial management and/or a technical master's in business administration program that teaches the skills needed in today's transport organizations. Training is also being conducted in the regions to guide regional personnel in using technical information to manage risk consistently across the network.

Transport for London

Transport for London reports that senior management understands that asset management is the key to delivering the agency's strategic objectives. It has found that investing time and effort early in the implementation process reduces resource needs later. In 2010, for example, the agency conducted an assessment of internal capabilities in the 15 areas shown in figure 17 (see next page). The agency's capabilities at the time of the survey are shown as the inner circle in red. At the same time, the agency assessed the

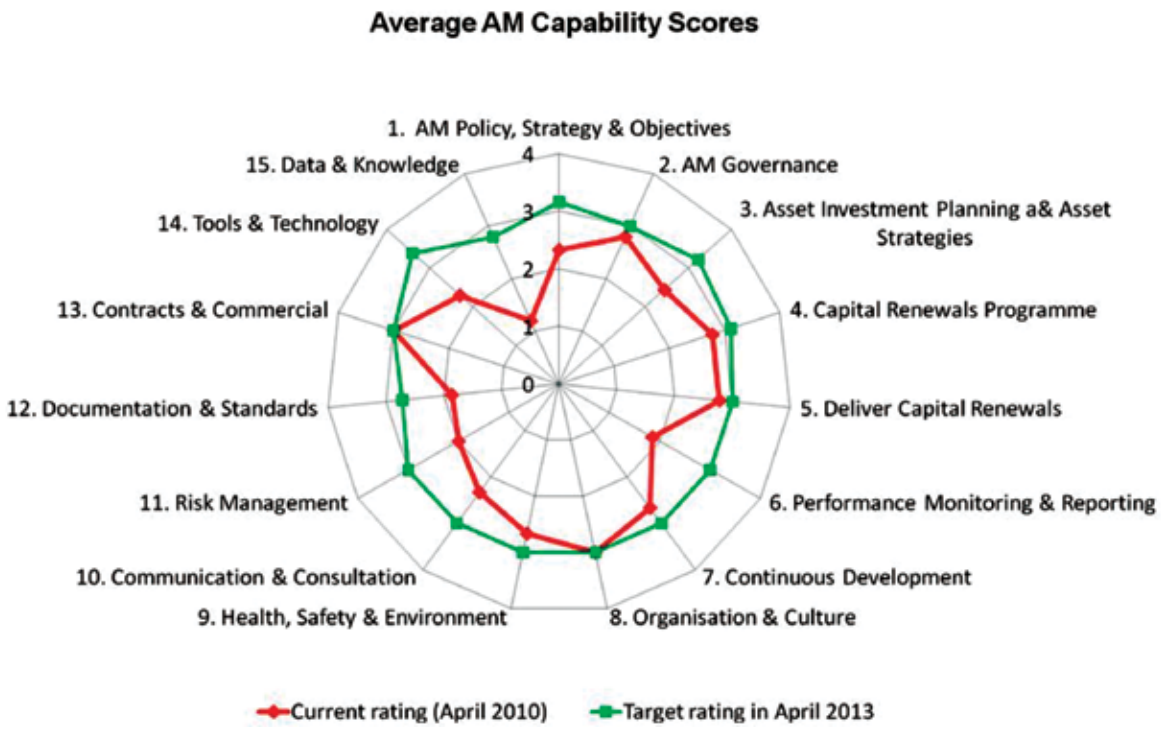

Figure 17. *Transport for London's assessment of asset management capabilities.*

desired capabilities, shown in the outer green circle. The spider graph clearly illustrates the gaps between desired and existing capabilities. For example, the organization and culture capability rating (area 8) is at the desired level, but substantial improvement could be made in the agency's data and knowledge (area 15).

The results of the gap analysis were used to develop plans for the continued enhancement of asset management plans to support the agency's decision process, shown in figure 18. The graph includes five improvement areas: (1) policies, strategies, and standards, (2) data and systems, (3) capital renewal program, (4) indicators and measures, and (5) sustainability and environment. The size of each box relates to the magnitude of the project and the color shows which asset is addressed. The action items in the graph reflect the results on an intellectual gap analysis the agency performed.

New Zealand Transport Agency

To be a world-class asset management organization, NZTA recognizes that it must have links between governance and skills. The agency also recognizes that the skills needed to be an asset manager are different from those required to be a traditional engineer because asset management requires more focus on strategic planning and risk. In addition, the asset manager must be able to communicate with and manage various stakeholders and understand financial and performance management.

NZTA noted that New Zealand has a serious shortage of skilled staff because of an aging workforce, changing skill requirements, education programs, and the desire of young workers to travel abroad. As a result, NZTA has focused on workforce sustainability, attracting and retaining key employees, building workforce capacity, and maintaining the well-being of the workforce. Succession planning is one component of the plan, which includes a career path, regular seminars, and a formal program of on-the-job training. The agency has also assessed competency gaps that will help determine the skills employees need to grow into their positions. NZTA reported that it is striving to build core competencies in the nine regional offices where its contracts are managed.

The agency supports initiatives that improve agency performance. For example, because of the difficulty in modeling pavement performance, 63 long-term pavement performance sites on state highways and 91 sites on local authority roads were established. These sites are used both to establish and calibrate performance models and to calibrate the data collection vehicle.

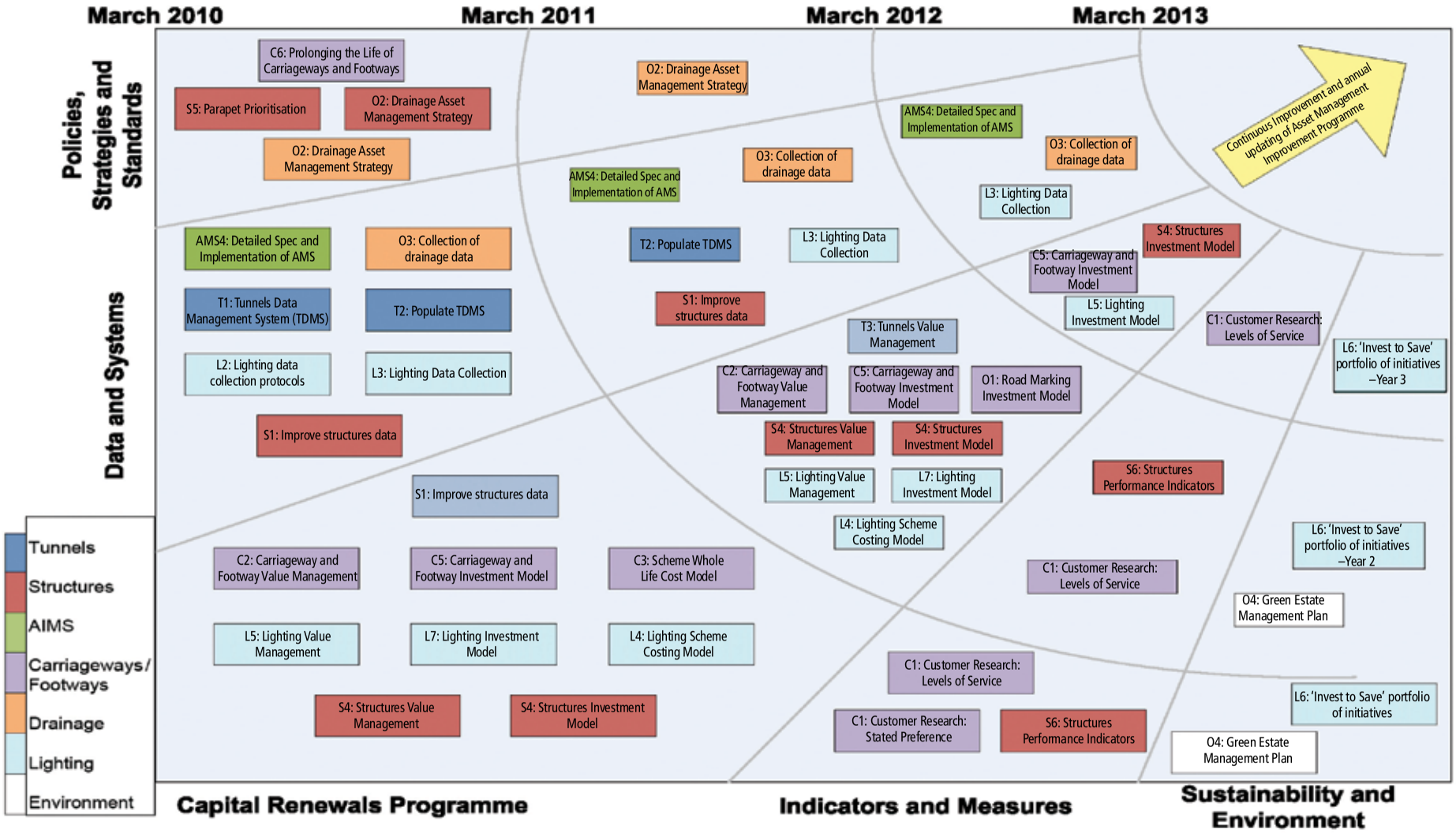

Figure 18. *Illustration of asset management development plans for Transport for London.*

VicRoads

Agencies that have outsourced maintenance and renewal activities must retain a certain level of skill and technical capability among agency personnel to set contract requirements, negotiate with contractors, and oversee their work. Several agencies participating in the scan indicated that they may have lost too much of their internal capabilities and are in the process of reestablishing them. For example, VicRoads noted problems with agency personnel conducting pavement evaluations. The agency responded by identifying a list of technical skills required for the job, establishing a postgraduate degree program to build expertise, and developing certification requirements.

VicRoads also establishes succession plans for replacing capabilities lost to retirement and recruiting from the private sector if it does not have the skills in-house. Now all employees have a list of capabilities required for their roles, and the agency maintains a computer registry of how those skills are satisfied. In addition to the external training programs available in Australia, VicRoads has both formal and informal mentoring programs and an 18-month graduate rotation program in which participants move into different positions every 6 months.

Figure 19. *Tools and templates developed and distributed by IPWEA.*

Highways Agency

The need for training and competency development has increased in the Highways Agency as a direct response to the budget reductions it has faced. The agency is developing the asset management skills of its staff and reviewing its technical standards to improve the efficiency of its maintenance and renewal activities while reducing impacts on the traveling public. In addition, the agency recognizes the need to build the right commercial skills because it relies heavily on outsourcing maintenance activities. In support of these activities, a master's degree program in maintenance and asset management is now offered through the University of Manchester.

Institute of Public Works Engineering Australia

IPWEA has identified three fundamentals for establishing a sustainable asset management program: work within a national framework, provide the tools required, and add drivers to motivate people to use the tools. As a result, IPWEA has taken the lead in Australia in developing a uniform set of templates and tools that many local agencies use, as shown in figure 19. The templates and tools, mostly Microsoft® Word and Excel files, have provided a consistent approach for implementing asset management principles. Most local agencies use the NAMS Plus modeling tool provided through IPWEA, although a smaller program is provided for small, rural, or remote communities.

IPWEA's approach has succeeded primarily because the tools and templates fill a void, they were developed by individuals respected in the field in a sustainable format, and user groups have been established for knowledge sharing and advancement. For example, the *Australian Infrastructure Financial Management Guidelines* were developed jointly by an asset manager, accountant, and economist so that the planning activities, regulatory activities, and applications all use a common approach. Agencies have embraced the opportunity to use a uniform approach to asset management, IPWEA has continually updated its products, and legislated and other incentives exist for using these products.

In addition to the training for elected officials, IPWEA offers a variety of other training programs for practitioners in Australia to help build capacity and develop careers. Its manuals serve as the basis for the training, but IPWEA considers the training instrumental for putting the content of the manuals into practice. It also provides Practice Notes on a variety of topics, including condition assessment, long-term financial planning, and asset management for small communities. IPWEA has partnered with the University of Tasmania to develop a graduate certificate or graduate

degree in asset management. It also offers a video that promotes asset management concepts.

Transport Scotland

One of the tools Transport Scotland uses to determine strategic gaps in performance is the results of its independent performance and financial audits. These audits have been influential in the agency's efforts to improve efficiency by at least 2 percent.

Transport Scotland also regularly benchmarks its practices with other countries as a way to improve its practices. Benchmarking is fully supported in the independent audits that are conducted. In addition to evaluating the performance outcomes achieved and the amount spent, the independent auditors consider the amount of benchmarking performed an important metric in assessing the quality of the agency's practices.

Transport Scotland recently conducted an internal assessment of its Asset Management Improvement Programme Work Packages to determine improvement areas. For each of the four areas shown in figure 20, the agency evaluated what it did, why it did it, and the benefits achieved from the activity. It found that inventory and condition data support each of the other program-development activities and that customer views influence priorities for both short- and long-term planning. As a result, customer views have a direct influence on the types of inventory and condition data that must be collected. Therefore, even though the four activities are shown independently, Transport Scotland recognized that they are highly interdependent in developing a customer-oriented program. The assessment of needed improvements led to new manuals for collecting inventory and condition data, a new condition scale that included five grades, annual customer surveys, and refinements to the level-of-service criteria used. In addition, the agency developed a methodology for long-term planning for ancillary assets and developed new guidance on value for money and software tools to assist with short-term planning.

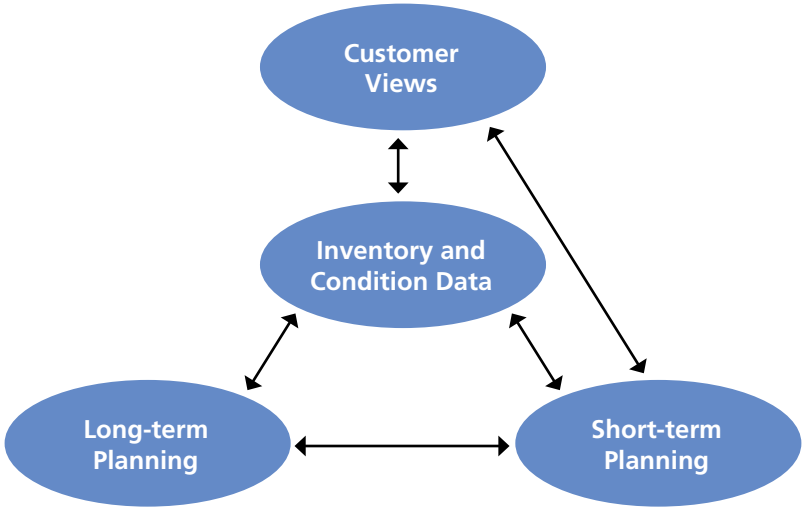

Figure 20. *Focus areas for assessing internal capabilities.*

The agency has also contributed to the development of skills in the private sector. For example, in areas of Scotland with fragile communities, Transport Scotland strives to grow small and medium business enterprises to perform contract maintenance work. The agency has targets for hiring local graduates and for putting people through training programs.

Norwegian Public Roads Administration

NPRA indicated it has begun to note its vulnerability because an individual who plans to retire soon has much of the agency's pavement management data collection expertise. The agency has identified sustaining competence as a major focus area because a large part of the agency workforce will retire in the next few years. Its efforts have included a research study to identify gaps in needed competencies and skills and to determine strategies for developing the needed competence for operations and maintenance. The agency has also established a training center in cooperation with the railway industry and a university. The agency is also striving to build more redundancy into its pavement management teams.

Finnish Transport Agency

The demand for pavement management experts is limited in the Finnish Transport Agency, so no formal training or mentoring takes place. However, the agency plans to have personnel work in pairs in all key activities. Training at the university level is also limited, with only a portion of one course at the University of Technology focused on pavement management. The four Nordic agencies participating in the scan have formed a Pavement Management User's Group to provide a forum for technology transfer.

Danish Road Directorate

Only about eight staff members use the pavement management system at the Danish Road Directorate, so internal training needs are limited. The agency regularly conducts general training for outside stakeholders, such as local municipalities, which includes a review of agency programs and facilities. The agency also conducts annual training for Research Institute staff

members responsible for conducting pavement condition surveys and estimating the residual life of the network.

In addition, research is considered an important component of building internal capabilities. To date, research has led to improvements in general economic models, deterioration models, and interpretation of measurements and data and incorporation of new parameters into the models.

Chapter 8. Efficiency and Value Drive Program Delivery Approaches

Most of the agencies the scan team met with contract out 100 percent of their pavement maintenance and renewal activities. According to the information the agencies 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. As agencies have gained valuable experience with these types of contracts, contractual terms have evolved, as have the performance metrics that drive contractor performance.

The participating agencies were frank about the advantages and disadvantages of the shift toward contracting maintenance activities. 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 expertise and are in the process of rebuilding. However, it has been a challenge to attract and retain skills in 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 DPTI found that outsourcing its maintenance activities forced the organization to consider performance requirements from a road user perspective and 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 level of risk 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 is using its fourth generation of outsourcing contracts and is still working on improvements to the documents. Issues agencies encountered as they embarked on the outsourcing of maintenance and renewal activities include the following:

- Most agencies have had to adjust their programs to ensure that the right performance metrics are used to drive the desired performance.
- Initially, agencies reduced their internal capabilities too significantly. Over time, these agencies have strived to rebuild their organizational competencies, but they are finding it difficult to attract engineers because the jobs involve more administrative than engineering tasks.
- In some instances, monopolies have formed that have limited the amount of competition for large projects. As a result, some costs are higher than expected.

On the other hand, most contract maintenance activities are performed as fixed-price contracts so the cost of maintenance is known and can be budgeted with certainty. Also, private sector costs are not subject to agency initiatives to improve efficiency, so there may be less interference with scheduled activities.

Transport Scotland

Transport Scotland is on its fourth generation of maintenance contracts, and each generation has enabled the agency to improve value, delivery, safety, and relationships. With the first generation of contracts in the 1990s, Transport Scotland provided assistance to the public to help establish the skills necessary to perform the required work. By the second generation of the contracts, the market was in a much better position to compete for the work. The agency is now working on being an attractive client by providing clear aims and goals, introducing innovation, and paying contractors within 10 days.

One of the biggest challenges Transport Scotland faces is the government's national performance mandate to improve government efficiency by at least 2 percent. The biggest impact on improving the efficiency of the agency's operation has been the procurement of road maintenance contracts. Another factor has been improved asset management practices, which save an estimated £3.4 million annually. However, some agency personnel are concerned that continued improvements in efficiency are not sustainable in light of the continued budget reductions expected. Transport Scotland has hired an independent specialist to evaluate its programs and provide advice on ways to reduce waste. This has led to changes such as reconstructing a single lane rather than both lanes on a given highway segment.

In addition to outsourcing maintenance and renewal activities, Transport Scotland outsources audit and performance assurance services, the latter of which evaluate the four regional maintenance contracts. In essence, the audits

serve as a form of quality control because the completed work is compared to the activities outlined in the road asset management plan. Since each regional contract includes several maintenance contracts, one of the auditor's recommendations was to standardize the reporting process across the region. Penalty points are assigned to a maintenance area contractor that does not deliver adequately, and after a certain number of points are accumulated, the contractor is required to correct its internal practices.

Highways Agency

A 2010 national audit found that only 20 percent of the projects selected for funding were being subjected to a whole-life cost analysis and there was little consistency in the program across an entire region of the country. In the past, each of the 12 areas prioritized its projects separately. As a result, there was no national coordination. Therefore, the Highways Agency implemented a new process that focuses more on the whole-life appraisal of projects and adopts a more active role in the design of the planned maintenance program in each area. The process includes the six stages shown in figure 21.

The process includes setting program objectives, developing area and regional program bids, developing a national program and budget, confirming programs and budgets, tracking delivery against planned programs, and auditing and continuous improvement. Development of the national program and budget as part of the process is new to the process, and the step in which programs and budgets are confirmed allows the Highways Agency to discuss programs among regions, directors, and the central office. If contractors do not deliver in accordance with the plan, penalties are applied. If a contractor acquires too many penalty points, the contractor is required to improve its processes. Incentives are built into the contracts for exceeding plan expectations. The Highways Agency reports that the new process has improved efficiency and the program is 12 months ahead of schedule.

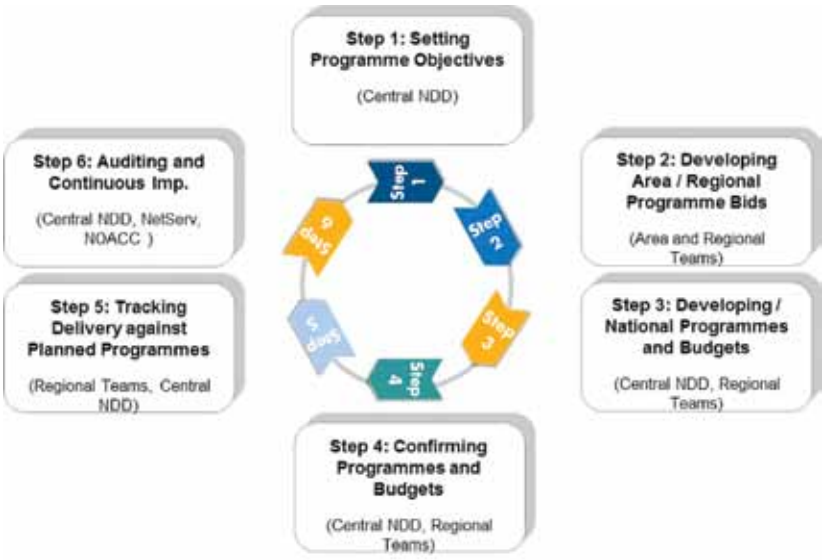

Figure 21. *Six stages in the Highways Agency maintenance program.*

In another example of efficiency improvement, the Highways Agency has established managed motorways in which the hard shoulder is used during times of high congestion. Electronic signs are used to manage traffic, and the strategy provides a way to address capacity needs on an as-needed basis without building new lanes.

The use of maintenance contracts was also driven by the Highway Agency's efforts to provide the best level of service possible for the lowest cost. When the Public Accounts Committee audited the maintenance contracts in 2010, it found that best practices were being used, but it challenged the Highways Agency to get more value out of the contracts without losing the focus on whole-life costs or creating safety problems. As a result, the agency initiated changes in the pavement standards and in the construction of the binder course. For longer term efficiencies, the agency is looking at strategies for strengthening analysis capabilities, improving workmanship, and lowering the intervention threshold.

VicRoads

The need to be more efficient and effective drove VicRoads to develop privatized maintenance contracts. The agency has used three different contracting approaches since it began outsourcing maintenance work. Initially, contracts called for contractors to work in accordance with schedules outlining certain activities. Over time, these evolved into fixed-price contracts, but the agency is now testing an alliance contract in one region that shares risk and reward and focuses on outcomes.

In addition to using external contractors, VicRoads sponsors a competitive maintenance workforce in the agency that competes with external contractors. When one of the internal teams competed in New South Wales for a sprayed-seal contract, it was found to be very cost-effective. These internal providers typically have strong links to industry and have represented VicRoads well. They also provide VicRoads with a better feel for the types of issues contractors deal with under these contracts and allow VicRoads to respond quickly if something goes wrong.

VicRoads reports that because of its priority on keeping moisture out of the road surface, contractors must patch and repair roads before any area has more than 100 square feet of deterioration. This early intervention keeps the roads safe and prevents them from deteriorating to the point that more extensive rehabilitation is required.

New Zealand Transport Agency

As in several other agencies, asset management became a focus of NZTA because of limited funding to manage its deteriorating assets. Both operational services and maintenance work are contracted out using a variety of contract delivery models that include conventional models, performance-specified maintenance contracts, and a hybrid of the two. Alliance contracts that share risk and rewards are also used to some degree. There is constant pressure in the agency to improve efficiency, largely driven by NZTA board mandates to improve efficiency by at least 2 percent.

To help improve agency efficiency, funding is provided to regional engineers in 3-year block grants so they have a high degree of certainty of the funding amount that will be available each year. Funding in the block grant can be used for operations, maintenance, and renewal projects, so regions have flexibility to move money between activity classes as needed. Vendors for maintenance contracts are prequalified, but about 80 percent of the work for network consultancy services goes to one vendor. Physical works are split among six to eight major contractors, with the top two conducting about 70 percent of all work. As a result, the agency fears a monopoly may be developing, which could result in higher prices in the future. However, NZTA has a strong culture of collaborating with industry to identify opportunities for improvements in efficiency to achieve required cost reductions.

Rijkswaterstaat

Rijkswaterstaat faces many of the same challenges as other organizations that contract out the maintenance and renewal of the road network. The agency indicated that there is constant tension between the interests of the agency and contractors. In most cases, agency personnel are suspicious of contractors' motivations and contractors look to the freedom of the market to drive contractual considerations. Transport agencies are under pressure to improve efficiency, get better value for the money, and reduce the number of civil workers, but this comes at a cost of lost technical expertise in the agency. Agencies also must deal with social initiatives and manage risk, which could lead to political change, financial risk to the country, and changes in the overall level of service it can provide to the public. As one strategy for managing risk in this environment, contractors must demonstrate the benefits of innovations before they are allowed to implement them under their contracts.

The service-level agreements the agency uses have evolved over time because of the difficulties of having regions operate independently. Previous versions of the agreements did not include much detail, so the regions had the freedom to interpret the agreements as they saw fit. Today the agreements are more detailed and include a prioritized list of projects that will be constructed over the 4-year term. As a result, the agreements have helped the agency better align the maintenance programs with the minister's policy goals.

South Australia Department of Planning, Transport and Infrastructure

The Department of Planning, Transport and Infrastructure began contracting routine maintenance activities in the late 1990s in response to the government's mandated privatization. This gave the department an opportunity to create a more business-focused, commercially driven funder-purchaser-provider model. Under this model, about half of the state's maintenance is outsourced to private contractors and the remaining department workforce manages to the same form of maintenance specification.

One advantage the department realized from outsourcing its routine maintenance activities was development of a specification that enables the contractor to manage the road network in a manner comparable to how the department would manage it. This required department personnel to carefully consider performance requirements from a road user perspective and 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 level of risk was considered acceptable and what was not.

Transport for London

Value management and value engineering are important strategies to driving down the costs of capital and operation maintenance at Transport for London. Value management techniques are used at the program level, and value engineering activities are used at the project level. At the program level, the value criteria consider both risk scoring and financial scoring. Risk scoring is based on an analysis of safety (in terms of the risk posed to the public), function (in terms of the risk to network performance), and environment (in terms of the risk to the environment). The financial scoring evaluates whole-life savings from reductions in direct costs to Transport for London or indirect costs to the economy. Scores are assigned for each major asset class and compared in terms of the total risk to the

agency. The agency is still refining this process, but initial findings indicate it will help improve the effectiveness of asset management programs.

Another Transport for London initiative was to clarify responsibilities and establish a clear decisionmaking process to improve organizational efficiency. These efforts resulted in a 2009 reorganization in which activities were combined into an expanded internal client division called Highways Asset Management. The new division combines data, performance modeling, analysis, and program organization in a single entity.

Swedish Transport Administration

The Swedish Transport Administration is contracting out 20-year design-build-operate-maintain contracts with safety, surface, and durability performance measures. The contractor must rent access to enter the road for maintenance activities, so there is an incentive to do the right treatment the first time and minimize the amount of time spent on the site.

Finnish Transport Agency

The privatization of the Finnish Transport Agency was instituted in response to the government's desire to downsize the organization and make road maintenance more effective. Overall, the program has worked well and the agency is relatively satisfied. It is too early to report on the success of the agency's long-term service agreements because those contracts were at the pilot stage at the time of the scan. The agency offers the following advice for success with privatized contracts:

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

Chapter 9. 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 provided several 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 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.

Chapter 10. 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 the FHWA's Local Technical Assistance Program to encourage adoption of the key findings at the city and county level.

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 visited agencies, 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 report, the executive summary, and presentations to committees of AASHTO, FHWA, State and local agencies, and TRB, the scan participants are committed to bringing the value of the scan into U.S. practice.

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RICHARD M. TETREAULT, P.E., (cochair) is director of program development and chief engineer of the Vermont Agency of Transportation. His responsibilities include leadership of the statewide highway capital improvement programs (roadway, pavement, bridge, highway safety, and traffic operations) from project scoping through construction. Each of these major programs uses some form of asset management principles coupled with performance measures, both supported by the State legislature during the budget development process. Tetreault's previous responsibilities include district transportation administrator for one of the nine State highway maintenance districts and chief bridge inspector. He has a bachelor's degree in civil engineering from the University of Vermont and is a licensed professional engineer. Tetreault is a member of the American Association of State and Highway Transportation Officials (AASHTO) Standing Committee on Highways.

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Appendix B. Amplifying Questions

Please provide the following information:

- General agency information, including the size of the pavement network and the number of districts, divisions, or regions. Include a summary of the role of each stakeholder in managing the pavement network and a characterization of the agency's decision process as centralized, decentralized, or mixed. In particular, the delegates are interested in the following:
  - What is the responsibility of the regional offices versus the central office in developing the pavement program?
  - What part of your organization is responsible for establishing the budget for pavement preservation?
  - Who is responsible for making the decision on the type and timing of a treatment for a particular road?
- A description of the different funding sources (revenue streams) that contribute to pavement infrastructure improvements, including information on restrictions placed on how money may be used. The delegates are also interested in how pavement preservation activities are funded (e.g., general fund taxes, user fees, borrowing) and whether there are any equity formulas (or statutes) in place that dictate how funding will be used (e.g., geographically).
- A summary of the adequacy of funding to meet network needs and any current trends in funding that your agency has experienced in recent years. In particular, the delegates are interested in determining the percent of existing pavement needs that are being met by the current level of available funding and whether that percentage has been increasing or decreasing in recent years.
- A description of how maintenance and rehabilitation activities are conducted using in-house personnel, contractors, or a combination of both. If the work is outsourced, please provide a summary of the following information:
  - What is covered under the contract (e.g., maintenance, rehabilitation, operations)?
  - How long is the contract period?
  - How much competition is there for these contracts?
  - How is the uniformity of quality and performance of treatments tracked?
  - How do you deal with suppliers or contractors who do not deliver consistent products?
  - Is the contractor or consultant at the table in making treatment decisions?
  - Are there warranty provisions in these contracts?
- A description of your pavement management software capabilities, including information on the type of pavement condition data used to determine maintenance needs and report network conditions. Information on the amount of money spent on pavement management activities as a percentage of the total capital improvement program would also be appreciated. In addition, the delegates would welcome information on the types of treatments considered in the pavement management system.
- A summary of the key performance measures that drive your program.

Information To Be Covered During Meetings With Scan Delegates

The following four topic areas will be explored in detail with each of the participating countries:

1. Use of sustainable performance-based programs for managing pavements
2. Identifying effective communication strategies to promote pavement management policies
3. Developing agency cultures to support pavement management policies
4. Availability of techniques and tools for managing pavements effectively

To address these areas, we are interested in meeting with those individuals who make investment decisions for the preservation and maintenance of pavements and other assets. Ideally, the group will include individuals responsible for making strategic and tactical decisions and those individuals who work with elected officials in setting agency policies for pavement (and other asset) preservation.

It is anticipated that each agency will present information on its practices in each of the four topic areas. When preparing agency presentations, representatives are asked to orient the presentations to the questions provided in this document.

Topic Area 1 Questions:
Use of Sustainable Performance-Based Programs for Managing Pavements

1. What are the primary factors that have led to good pavement management decisions within your agency? What was the trigger that motivated your current practices?

2. How did you create the framework for a sustainable pavement management model? Please include information on how you built support for this framework and the types of challenges you overcame.

3. What role do public officials, agency personnel, the private sector, and the public have in your pavement management decisions? How have you built support for these decisions within each stakeholder group?

4. To what degree does pavement management information influence highway policies, investment decisions, and treatment selection? Is pavement management information considered separately or as part of an asset management model that considers other assets and modes of transportation? To what degree is a formal risk assessment a part of your decision process? Please explain your responses.

5. How does your agency describe pavement preservation and what percentage of your budget is spent on these types of treatments? How do you determine the appropriate amount of money to be spent on pavement preservation activities?

6. Describe the strategic, tactical, and operational performance measures that are used to manage your pavement network and how performance targets are established. Indicate whether targets are set based on the results of an optimization analysis, customer feedback, or some other method.

7. How have you reconciled national versus local or provincial authority in determining uniform performance measures and tools? For example, in the United States different methods of reporting pavement conditions have been adopted and/or different methods of collecting information are used. How important do you think it is to have common performance measures and data collection procedures?

8. How does your agency know that the current business model is better than previous models? For example, are benefits documented? Does money go further than it did before? Are stakeholder needs better addressed?

Topic Area 2 Questions:
Identifying Effective Communication Strategies to Promote Pavement Management Policies

Please provide examples of the types of information your agency provides to keep staff, the public, and elected officials informed of current pavement conditions and to document the impacts of your agency's pavement management decisions.

1. Please describe your agency's experience with the various forms of communication that have been used with different stakeholder groups, including any experience your agency has had with Web-based programs, social media, and focus groups. What methods have worked best? Worst? What methods have you tried in the past that have not worked as expected?

2. What tools and methods does your agency use to evaluate customer needs and wants? How does the information you obtain influence agency decisions and policies? What changes were required in the decision processes to incorporate customer input?

3. What has been the most effective information your agency has used to drive executive management and elected officials to make smart, long-term decisions?

4. How have your agency's methods of communication changed with time? For instance, has your agency modified the information or level of detail reported?

5. How does your agency determine the effectiveness of its communication methods? What metrics are used and how frequently are they evaluated?

6. How closely does the information reported to the public match the performance metrics that are used to drive the pavement preservation program? If there are differences, how does your agency address these discrepancies?

Topic Area 3 Questions:
Developing Agency Cultures to Support Pavement Management Policies

1. What steps did your agency take to develop a culture that supports long-term investment in pavements? For instance, what knowledge was shared with senior management and policymakers that allowed for them to buy in to the changes?

2. What motivated the transition to privatized maintenance in your agency? What impact has this decision had on your agency, both positive and negative?

3. How are the cultural incentives to improve performance institutionalized? For instance, do you reward those who improve performance with more funds or do you redirect resources to bolster areas that may be struggling to meet the performance standard? In general, what incentive is there to improve?

4. Please describe the degree to which data, analyses, and decisions are integrated in your performance-based organization. For instance, are material, construction, design, maintenance, and planning factors considered in the decision process? If so, how was this degree of integration achieved and how long did it take to achieve it?

5. What types of training and/or mentoring are in place to sustain your agency's culture? Are there specific training programs focused on pavement management? If so, what is included in the training program and who is expected to participate? How do you educate stakeholders who do not operate the pavement management system, but who are involved in decisions using pavement management information?

6. What challenges have you faced as you have strived to maintain a performance-based culture over time? For instance, has your agency had to reaffirm the benefits of pavement preservation to decisionmakers? Have there been instances in which the public has expected performance targets that were unrealistic? Have there been barriers that have been particularly difficult to overcome?

7. Have you had any situations in which initial performance metrics did not support the level of performance your agency was hoping to see? How did you address these situations? Further, are there any examples of performance measures that were found to be ineffective, but that leaders or elected officials refused to change?

8. What role does research (or do research findings) have in supporting your asset management activities? In particular, the delegates are interested in the importance of agency-sponsored research when most of the pavement maintenance activities are contracted out.

Topic Area 4 Questions:
Availability of Techniques and Tools for Managing Pavements Effectively

1. Describe the role of available technology and tools in supporting your decision processes. Specifically, what parts of the decision process are well supported by available tools and what aspects need further development?

2. What types of technology and tools are in place to be able to show that your agency's current program is effective? In other words, does your agency have a way to demonstrate that performance management is working?

3. Please explain how your agency's decision process considers corridor and/or multimodal needs in conjunction with existing and predicted pavement needs. For example, do you have tools in place to support cross-asset optimization (e.g., pavements, bridges, and safety appurtenances)? If so, how is this analysis performed? Please describe the tools your agency has in place, and identify any tools under development to further support this analysis. Who is involved in the process and how do they interact?

4. Was privatization a part of a recommended pavement management strategy, or was it driven by some other factor? In your opinion, has it worked as expected? Why or why not? What advice would you offer to other agencies that are considering privatization as a pavement management strategy?

5. How has your agency developed its pavement performance models? Do your models consider pavement structural conditions? Do you have performance models for all assets you are managing?

6. How well do your agency's tools adapt to changes in vehicle weights, tire pressures, policy decisions (e.g., policies to use quieter pavements), and changing stakeholder needs? Have you been able to use these tools to demonstrate the impact of possible political initiatives to elected officials? Please explain.

7. How is success in pavement management rewarded within your agency? For example, are managers or contractors rewarded for meeting strategic goals or targets? Are there consequences if targets are not met? Please explain your responses.

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