

**GEORGIA DOT RESEARCH PROJECT RP 11-08  
FINAL REPORT**

**Transportation Asset Management:  
Organizational Performance and Risk Review**



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# Transportation Asset Management: Organizational Performance and Risk Review

## FINAL REPORT

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**November 15, 2012**

## A Guide to this Report

The 2012 federal Reauthorization of Surface Transportation Programs, Moving Ahead for Progress in the 21<sup>st</sup> Century (MAP-21) formally introduced performance-based decision making for investments in surface transportation programs. MAP-21 aims to integrate ongoing activities in performance measurement/management, strategic planning/management and asset management in state Departments of Transportation (DOTs) into focused initiatives with goals, objectives, performance measures and targets that are applied to demonstrate improved performance over time. This study outlines authoritative definitions and characteristics of performance management; presents effective and leading practices in performance management in selected state DOTs; and benchmarks Georgia Department of Transportation's (GDOT) performance management program against these practices – using a gap analysis and recommending actions that GDOT can take to advance their performance management capabilities to the next level. The study develops a performance management diagnostic tool for evaluating the status of a performance management program in an agency and making recommendations to address gaps to advance the program. In addition, the study reviews tradeoff analysis applications in the literature; surveys state DOTs to determine their applications of tradeoff analysis approaches at the program level, and recommends a methodology for harnessing existing asset management tools and data at GDOT to conduct program-level tradeoff analysis.

The results of the study are presented in three volumes. Vol. 1 presents the purpose and methodology of the study with the report organization (part 1); synthesizes the literature review findings (part 2); reports on the findings from the state-specific case studies (part 3); and presents the performance management maturity model and self-diagnostic tool (part 4). Appendix A provides the full literature review; Appendix B provides the full case studies for the 18 state DOTs that were studied; Appendix C provides the performance management executive checklist to be used by upper level management to evaluate the status of performance management within their agencies; and Appendix D provides full technical details on the self-diagnostic tool. Vol. 2 reports on the status of applications of tradeoff analysis approaches in the 50 state DOTs and Washington D.C. Vol. 3 of the report is a confidential document that presents a gap analysis of performance management at GDOT and recommendations to advance the agency to the next level or leading practice status in performance management.

# **Leading Practices in Organizational and Transportation Systems Performance Management**

## **Volume I: State DOT Benchmarking Study**

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# Table of Contents

- I. Introduction ..... 1**
  - 1. Sponsor Information ..... 2
  - 2. Purpose of the Study ..... 2
  - 3. Study Methodology ..... 2
  - 4. Report Organization ..... 2
- II. Literature Review Summary ..... 3**
  - 1. Background and Relevance of Performance Management ..... 4
  - 2. The Practice of Performance Management ..... 5
    - 2.1 Organizational Structure and Processes of Performance Management ..... 6
    - 2.2 Selecting Performance Measures ..... 6
    - 2.3 Collecting and Managing Performance Data ..... 7
    - 2.4 Setting Performance Targets ..... 7
    - 2.5 Using Performance Information to Develop Programs and Allocate Funds ..... 8
    - 2.6 External Reporting and Communication ..... 8
  - 3. References ..... 9
- III. Findings from State-Specific Case Studies ..... 11**
  - 1. Background and Methodology ..... 12
  - 2. Selecting Performance Measures and Other Indicators ..... 12
    - 2.1 Organizational and Systems Measures ..... 12
    - 2.2 Performance and Context Measures ..... 13
    - 2.3 Top-down and Bottom-up Approaches ..... 13
  - 3. Organizing Performance Measures ..... 13
    - 3.1 Organization by Goal Area ..... 14
    - 3.2 Organization by Functional Category ..... 14
    - 3.3 Connecting Functions to Goals ..... 14
  - 4. Trends and Targets for Tracking Progress ..... 14
    - 4.1 When and How to Use Trends ..... 14
    - 4.2 When and How to Use Targets ..... 15
  - 5. Use of Performance Measures in Decision Making ..... 15
    - 5.1 Daily Use ..... 15
    - 5.2 Monthly, Quarterly or Annual Use ..... 16
    - 5.3 Decisions Affecting Organizational Performance ..... 16

- 5.4 Decisions Affecting Systems Performance ..... 16
- 5.5 Scope of Influence, Communication, and Collaboration..... 16
- 6. Performance Management in the Organizational Structure ..... 17
  - 6.1 Ownership and Accountability ..... 17
  - 6.2 Balancing Centralization and Decentralization ..... 17
- 7. Reporting ..... 18
  - 7.1 External Reporting ..... 18
  - 7.2 Gaining Credibility ..... 19
  - 7.3 Internal Reporting..... 19
  - 7.4 Multiagency Reporting ..... 19
  - 7.5 Dynamic Reporting..... 20
  - 7.6 Graphical Elements ..... 20
  - 7.7 Reporting Comparisons ..... 20
  - 7.8 Multiple Spatial Scales ..... 21
- IV. Maturity Model and Self-Diagnostic Tools ..... 22**
  - 1. Background and Methodology..... 23
    - 1.1 From Generations to Stages of Maturity (Literature Review) ..... 23
    - 1.2 From one Model to two Tools (Expert Panel) ..... 23
    - 1.3 Refining the Model and Tools (Case Study Interviews)..... 24
  - 2. Complete Maturity Model and Executive Checklist ..... 25
- Acknowledgement ..... 27

**APPENDIX A: Literature Review**

**APPENDIX B: In-Depth Agency Case Studies**

**APPENDIX C: Performance Management Executive Checklist**

**APPENDIX D: Diagnostic Tool**

## **List of Tables and Figures**

- Table 1: States for which DOT case studies were conducted, grouped by region ..... 12
- Table 2: Maturity Model for Organizational Performance Management ..... 25
- Figure 1: Levels of Maturity Characterized by the Maturity Model..... 26

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## **I. Introduction**

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## 1. Sponsor Information

This Benchmarking Study was contracted by the Georgia Department of Transportation (GDOT) as part of a broader project to help enhance its performance management program.

## 2. Purpose of the Study

The purpose of this study is twofold:

1. To identify the leading practices in organizational performance management at state departments of transportation in the United States, and
2. To identify potential next steps that GDOT can take in order to enhance its performance management program and develop best or leading practices

## 3. Study Methodology

This Benchmarking Study used a four-phased methodology:

1. Extensive literature review identifying leading practices in organizational performance management
2. In-depth case studies of 18 state DOTs, which were identified from the literature review as leaders in organizational and transportation systems performance management
3. Development of a maturity model and two self-assessment tools (an executive checklist and a diagnostic tool for performance management programs at state DOTs)
4. Calibration of the assessment tools through in-depth interviews with 10 DOTs that were identified based on expert advice – Some of the information gleaned from these case studies was integrated into the state-specific case studies.

## 4. Report Organization

The remainder of this report provides methodologies and results, as follows.

- **Section II** summarizes the findings from the literature review. The complete literature review report is provided in Appendix A.
- **Section III** provides a methodology and synthesized results from 18 state-specific case studies. Full case studies are provided in Appendix B.
- **Section IV** summarizes the development process for the maturity model and self-assessment tools. The complete executive checklist is provided in Appendix C, and an in-depth description of the diagnostic tool (including example screenshots) is provided in Appendix D.

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## **II. Literature Review Summary**

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The literature review was approached as a way to determine the current best practices of performance management among transportation agencies and touches on several key elements of the process: organizational structure, performance-based strategic planning, selecting performance measures, collecting and managing performance data, setting performance targets, funds allocation and programming, and external reporting and communication. Some key findings in these areas are presented in the next few sections.

## 1. Background and Relevance of Performance Management

As defined by the American Association of State Highway and Transportation Officials (2010), performance management is “an ongoing, systematic approach to improving results through evidence-based decision making, continuous organizational learning, and a focus on accountability for performance [1]. NCHRP Report 660 describes performance management as “the regular ongoing process of selecting measures, setting targets and using measures in decision making, and reporting achievement, leading to the development of a culture of performance throughout [an] agency” [2]. More and more, transportation agencies in the United States are turning toward *performance management* to help them meet increasing demands for mobility and accountability in the context of limited resources.

Transportation-related performance measures have been used in the United States for decades, with measures related to pavements and bridges having emerged during the 1960s and '70s. Since 1990, Federal legislation and AASHTO initiatives have gradually encouraged movement from simply measuring to actively managing performance. The three funding reauthorizations for surface transportation that were passed between 1990 and 2010 (ISTEA, TEA-21 and SAFETEA-LU), and two Government Performance and Results Acts (GPRA), all include elements of performance measurement and performance-based decision making. In 2012, the reauthorized transportation funding bill, Moving Ahead for Progress in the 21st Century (MAP-21), explicitly established national performance goals for federal highway programs, and took other important steps to formalize a national policy for performance-based transportation decision making.

The seven national performance goals established by MAP-21 are:

- **Safety** – To achieve a significant reduction in traffic fatalities and serious injuries on all public roads
- **Infrastructure condition** – To maintain the highway infrastructure asset system in a state of good repair
- **Congestion reduction** – To achieve a significant reduction in congestion on the NHS
- **System reliability** – To improve the efficiency of the surface transportation system
- **Freight movement and economic vitality** – To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development
- **Environmental sustainability** – To enhance the performance of the transportation system while protecting and enhancing the natural environment

- **Reduced project delivery delays** – To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices [3].

These national performance goals were informed, in part, by the experience of state transportation agencies across the United States; according to a 2010 study [4] the top five goal areas that are important to state departments of transportation (DOTs) include safety and security, asset management and preservation, transportation systems efficiency, organizational development, and customer satisfaction. Example performance measures related to each of these goal areas are provided in the complete literature review conducted for this study (Appendix A of this report).

## 2. The Practice of Performance Management

In a transportation context, the business practice of performance management can integrate several of the traditional activities of a transportation agency (or even multiple agencies), such as strategic planning, long-range planning, human resource management, project selection, and project prioritization and programming. One way to view the business practice of performance management is as a cycle of interlinked processes, associated with the development and use of performance information [5, 6] as follows:

1. Formulate performance measures to support an agency's strategic goals and objectives;
2. Collect, manage and analyze data in terms of the formulated performance measures;
3. Use performance information in decision making to design new programs or projects, and to periodically update goals, objectives and targets.
4. Track and report performance information to political decision makers, stakeholders and peers, in order to determine and demonstrate progress towards performance objectives and targets.

Steps 1 and 2 characterize *performance measurement*, whereas *performance management* includes steps 3 and 4 as well. Thus, performance measurement is only one of several elements of performance management. Based on the literature review completed for this study, an effective performance management system incorporates the following six principles:

1. Performance measures are relevant to the agency's strategic goals, which relate to both effectiveness and efficiency.
2. Performance information is used in decision making to improve the agency's effectiveness.
3. Measures exist and are used at the agency-wide level as well as the level of individual functional units.
4. Different measures are carefully chosen for different purposes, including measures that are used internally to track the effectiveness of the agency and the

transportation system, and measures that are used externally to publicize the agency's progress to its external stakeholders.

5. Each performance measure or measurement area has one or multiple "champions" or "owners," who collect and manage data and/or make decisions that will affect performance results.
6. Measures related to outputs, which are entirely attributable to the agency's actions, are linked with measures related to outcomes, which are important and meaningful to external stakeholders.

## 2.1 Organizational Structure and Processes of Performance Management

While the actual structure of the performance management work flow may vary from agency to agency, the literature suggests that there are some basic guidelines for managing personnel involved in the performance management process. Firstly, *the entire agency must function as an integrated whole* to ensure that performance information is recorded accurately, analyzed thoroughly, and utilized to work towards agency-wide goals. It is critical to distribute these responsibilities among the agency's staff in an organized, efficient way that encourages collaboration and communication across and among the agency's functional units. Once responsibilities are delegated, it is important to *keep staff motivated and engaged in the performance management process*. Staff must fully recognize the value that their work brings to agency-wide performance. Executive and senior-level managers can help keep other staff engaged and motivated by providing resources for training, assigning some leadership roles to other staff members, keeping the lines of communication open across the agency hierarchy, and rewarding innovation and high-performance with special recognition. Finally, *staff members must be accountable for their contributions to the performance of the agency*; this can be accomplished as performance monitoring is integrated into the day-to-day work of the agency, and as staff members have conversations with their managers about day-to-day performance on a regular basis. [2, 7, 8, 9, 10, 11]

## 2.2 Selecting Performance Measures

By selecting an effective suite of performance measures, an agency translates its strategic goals into action items. By evaluating their defined performance measures on a regular basis, the agency tracks its progress and effectiveness in meeting its stated goals. When it is based on current and accurate data, the information provided by performance measurement allows the agency to adjust its future actions in order to improve performance.

The literature review identified four principles for designing a suite of performance measures [12, 8, 9, 13, 14]:

- *Meaningfulness* – Measures should be clearly defined and understandable to technical and non-technical audiences, as appropriate. They should also relate directly to the agency's goals and objectives.
- *Practical Measurability* – Measures should be easily tracked and evaluated and have associated data that are readily available. Measures should be numeric;

however the underlying data need not always be quantitative, as some qualitative data can be quantified.

- *Comprehensiveness and Balance* – An effective suite of performance measures will provide a balanced picture of the agency’s effectiveness, including measures related to inputs, outputs, outcomes, and efficiency.
- *Conciseness* – A suite of measures should not be overly large or complex because this can lead to difficulties in communication and can complicate the decision-making process.

### 2.3 Collecting and Managing Performance Data

Different types of performance data are used for different purposes. Some data (for example, data that identifies existing problems or forecasts future problems) are used to inform decisions such as project selection, before the agency takes any permanent action. To generate this sort of data for decision making, predictions must be made using modeling or statistical methods. Other data are collected “post-occupancy,” after the agency has taken actions. Post-occupancy data are based on existing conditions, and they are used to determine how well an agency’s actions are achieving their intended purposes [15]. An agency can guide itself to the most appropriate data sources for different purposes by answering at minimum six questions [16]:

1. What needs to be measured?
2. Where should measurements be taken?
3. Is it necessary to measure the presence or absence of something, or must the degree or magnitude be measured?
4. How accurate and precise must the measurements be?
5. Must measurement occur at a particular point in time?
6. How often should measurements be taken?

### 2.4 Setting Performance Targets

Performance targets define numerical performance levels that an agency wants to achieve at a particular time. In general, the following attributes of effective targets can be distilled from the literature [9]:

- *Timebound* – Targets can be short term, mid-range or long term. The appropriate time scale for a target will depend on the decision-making context in which it is used. Often short-term targets can be used along the way toward achieving a long-term goal.
- *Achievable* – Targets should be both technically and financially feasible, and therefore based on plausible funding projections and reasonable forecasts of condition and performance.
- *Strategic* – Long term targets are primarily based on the goals and ideals of the agency, while short-term and mid-range targets can be developed in order to make progress toward the long-term goal.
- *Well-communicated* – In order to be an effective decision making tool, performance targets must be effectively communicated alongside actual performance. That way, decision makers can make adjustments in policy and programming in order

to make better progress toward long term goals, or to save money when progress is well under way.

## 2.5 Using Performance Information to Develop Programs and Allocate Funds

Performance measures are perhaps most effective as management tools when they are used to inform investment decisions. Some states have institutionalized this process through legislation or formal procedures. In any case, the key to success in this area is flexibility; from one funding cycle to the next, decision makers must be able to change investment strategies in order to address any needs and priorities identified by performance information. By considering performance information each time funding is allocated, on a regular cycle, an agency can collect a body of evidence about how effective its day-to-day actions have been over time. Some principles of this ongoing process include the following [7, 9]:

- Some of the same performance information that is used in a variety of agency functions should also be used to make investment decisions
- The information used to allocate funds should also include both existing conditions and forecasted data
- Decision makers should closely consider the economic ramifications of both past investments and (multiple) future investment options through such tools as return-on-investment, cost-benefit analysis, and tradeoff analysis
- Short-term and long-term targets set the context in which agencies can evaluate the effectiveness of their investment decisions, and choose how to allocate funds based on projected outcomes
- Funding allocation should be informed by the data feedback of performance measures and also the goals established in strategic planning

## 2.6 External Reporting and Communication

Performance reporting is a necessary component of any performance management program. Reporting to external stakeholders improves the accountability of the agency and builds credibility and trust between the agency, the public, and/or other government officials. It is not only important that performance reporting be accurate—it should also be communicated clearly and effectively. This is important because transportation agencies often depend on their external stakeholders to provide necessary resources, such as funding and political support [17]. Three principles of effective data presentation have been distilled from the literature:

- *Accessibility* – Performance reports should be easy to understand to the intended (often non-technical) audience. Reports should also be readily available to the general public via the web and other relevant media.
- *Attribution* – When direct causal relationships are difficult to construct between certain outcomes and agency actions, relationships should be demonstrated through before-and-after studies or through the use of traffic simulations and trends in relevant data [9].
- *Transparency* – All assumptions and direct or indirect relationships should be made clear to the public when presenting performance data to avoid confusion or

misrepresentation and to ensure that the public does not draw any unrealistic conclusions or expectations from the performance data [2].

There is a variety of reporting styles among DOTs. Some report performance data via the agency website, while others release a full performance report. Performance websites are interactive and should be easy to navigate, while performance reports tend to provide more detailed information about the performance measures, targets, and processes. Both performance websites and performance reports often incorporate graphical components to help convey the performance information. Dashboard graphics, for example, often use traffic-light colors (green, yellow, and red) to portray whether or not an agency is meeting its performance targets. Time-series charts are often used to display performance trends over time. These graphical elements also provide several types of information in a condensed space, including numerical targets, ranges of acceptable performance, actual performance levels, and achievement gaps. Examples of graphics from transportation performance reports are included in the complete literature review (Appendix A) and the complete case studies (Appendix B) of this study.

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### **III. Findings from State-Specific Case Studies**

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## 1. Background and Methodology

Case studies were conducted for eighteen state DOTs across the United States, as shown in Table 1. Case-study agencies were identified through the literature review as leaders in performance measurement or management. For each of these DOTs, performance management practices were investigated based on details that are publically available online, for example in strategic planning documents, organizational charts, performance reports, and online dashboards. Ten case studies (those marked with asterisks (\*) in Table 1) also incorporate information from interviews. The interviewed states were selected based on recommendations by a panel of experts from industry, academia and government. The primary purpose of the ten interviews was to calibrate the Interactive Self-Diagnostic Tool developed in association with this study; information for case studies was gathered incidentally. Prior to the publication of this report, all case-study agencies were given the opportunity to review their case studies for accuracy, and to provide feedback or corrections; those that responded are marked with a double dagger (‡) in Table 1.

**Table 1: States for which DOT case studies were conducted, grouped by region**

<u>Midwestern States</u>	<u>Eastern States</u>	<u>Western States</u>
Kansas **‡	Connecticut	California **‡
Michigan‡	Florida	Oregon **
Minnesota **‡	Maryland *	Utah‡
Missouri **‡	Virginia **‡	Washington **‡
Montana	Georgia *	New Mexico‡
Texas‡	North Carolina‡	Colorado**

Information was gathered for each case study in the following areas:

1. What performance measures are used how these measures are organized;
2. How agencies measure progress toward their strategic goals;
3. Whether or not performance measures are linked to decisions such as resource allocation, and how such a linkage is made;
4. How performance measurement and management are reflected in the agency’s organizational structure and processes; and
5. How reporting is used internally and externally to convey information to important stakeholders.

Specific details for each of the case study agencies are provided in Appendix A of this report. Synthesized results are reported below.

## 2. Selecting Performance Measures and Other Indicators

### 2.1 Organizational and Systems Measures

In a transportation agency, organizational performance and systems performance are closely linked because the mission of the agency largely involves managing a transportation system. However, most of the DOTs reviewed for this study do track some performance measures that are more organizationally focused (organization-related inputs, outputs, processes, and efficiency measures), as well as measures that are more systems focused (systems-related outputs and outcomes).

## 2.2 Performance and Context Measures

Most agencies reviewed for this study use a combination of *performance measures* and *context measures*. Performance measures can be directly linked to and influenced by actions taken by an agency; they are relevant to agency's function, mission, and strategic goals. Context measures (or tracking indicators, as they are called by Minnesota DOT) include population growth and growth in vehicle miles traveled, as well as inputs such as funding received and asset inventories. Context measures can influence decisions in transportation planning and can influence transportation system performance, but they do not necessarily reflect agency performance.

## 2.3 Top-down and Bottom-up Approaches

Transportation agencies select their performance measures using a combination of "top-down" and "bottom-up" approaches:

With a top-down approach, performance measures are selected because they are directly related to the strategic vision of the agency. Top-level managers who define the strategic vision, mission, and goals of an agency are also more likely to be directly involved than front-line employees in selecting performance measures. Some measures may even be mandated by an external stakeholder such as the state governor or legislature. Performance measures selected using a top-down approach tend to be more outcome-oriented and tailored for reporting to external stakeholders.

A bottom-up approach to selecting performance measures depends heavily on the input of front-line employees and mid-level managers who use the measures to track the performance of their own functional units. Performance measures selected from the bottom-up tend to be directly linked to the day-to-day functions of the agency, more output-oriented, more technical, and tailored for internal use.

Performance management programs that have been evolving for many years tend to include both outcome-oriented and output-oriented measures. Effective performance management depends on the connection between an agency's outputs and its outcomes. In other words, agencies need to demonstrate how their day-to-day activities affect the outcomes that are important to stakeholders.

## **3. Organizing Performance Measures**

There are also two main ways that an agency may choose to organize its performance measures in a performance report or database:

### 3.1 Organization by Goal Area

Measures may be categorized by strategic goal, policy area, or other important outcome area in order to be clearly relevant to the "bigger picture," which is important to stakeholders. An agency may be more likely to present its performance measures in this way if they are already selected using a top-down approach. However, measures selected using a bottom-up approach can later be categorized in this manner for the purpose of external reporting. With this organization, a challenge may arise for some performance measures that are relevant to multiple outcome areas.

### 3.2 Organization by Functional Category

Measures may be organized by functional categories (such as Highway, Passenger Transport, Freight, Maintenance) in order to be clearly associated with a particular office or division within the agency. A challenge may arise when external reports are organized this way if certain measures span multiple categories, or if they depend upon the action of multiple functional units. This sort of presentation may be more appropriate for internal databases, which are meant to be used by the agency employees in their day-to-day work.

### 3.3 Connecting Functions to Goals

When performance measures are categorized according to strategic goal areas, several states identify one or multiple people, positions, or functional units that are responsible for each measure. Terminologies for these individuals and groups vary: for example, they may be called "owners" or "drivers." Missouri DOT further identifies "measurement drivers" and "results drivers." By naming these people or groups in their public performance reports, agencies demonstrate accountability and indicate how agency functions contribute to achieving strategic goals. Accountability can be similarly demonstrated if performance measures are already categorized according to functional unit by listing which strategic goal(s) are contributed to by each performance measure. Some agencies also provide contact information for performance "owners" in their public reports.

## **4. Trends and Targets for Tracking Progress**

Transportation agencies use performance trends and targets to help evaluate whether or not they are achieving, or are at least on-track to achieve desired goals and objectives. Trends are expressed in terms of increases and decreases over time, whereas targets identify a desired value or range (for example 100% or a minimum of 45 mph). Often, but not always, targets also identify a desired timeframe for achievement (for example, by 2015) for a given performance measure.

### 4.1 When and How to Use Trends

Most transportation agencies track trends for both *performance* measures and *context* measures. Performance measures can be directly linked to and influenced by actions

taken by an agency; it is important for all performance measures to be tracked over time, for a desirable trend direction to be defined (increasing or decreasing), and for measured trends to be compared with the desired direction. Context measures can influence decisions in transportation planning but do not reflect agency performance. While it is often important to track context measures over time, it may or may not be appropriate to associate them with desired trend directions. By analyzing the trends of context measures alongside those of performance measures, agencies can identify elements of their overall social and economic context, which they miss otherwise. With this information, agencies can better identify contextual factors that may also impact agency performance. These contextual factors may present obstacles and/or opportunities that agencies should consider as they work toward achieving their performance targets.

#### 4.2 When and How to Use Targets

Numerical targets are only appropriate for performance measures, never for context measures. Some transportation agencies associate a target with every one of their performance measures, while others use targets sparingly. Some agencies define time frames for achievement (often one to three years) for their performance targets, whereas others do not. Numerical targets without timeframes can be called “aspirational targets.” Often, an aspirational target expresses an ideal level of performance, which is desirable but unlikely to be reached due to confounding factors such as user behavior. An example aspirational target used by Utah, Washington State, and Minnesota DOTs is “zero fatalities.” Aspirational targets function like desired trend directions in practice. This means that performance is improving if it moves toward the aspirational target, and there is no implication of failure if the target is not reached. The primary difference between an aspirational target and a desired trend direction is that the numerical target value can appeal to stakeholders by demonstrating that the agency cares about their needs.

In general, the right choice of whether or not to define a numerical target and/or a time frame for achievement depends primarily on the extent to which an agency can influence the performance measure at hand. The level of agency-influence depends on the influence of confounding factors, the availability of funding, and technological capability. When agency-influence is limited, or if funding or other resources are uncertain, aspirational targets may be appropriate.

## **5. Use of Performance Measures in Decision Making**

The frequency with which an agency uses performance measures in decision making is primarily limited by the frequency with which updated performance measurements are collected and calculated. The types of decisions that performance information may influence depends on what is being measured. The effectiveness of decisions that are based on performance data will depend on the extent to which an agency adopts an attitude of learning and remains flexible to adapt its actions based on what is portrayed by performance measures.

### 5.1 Daily Use

Some inputs and most outputs can be tracked and (with a sufficient data management system) reported on a daily basis; these can be used for day-to-day resource allocation (such as assigning work tasks to staff members) without much need for data processing. Some outcome measures can also be tracked and managed in real time, so long as the agency has sufficient influence over them. For example, traffic congestion depends largely on user behavior, but many agencies track it and watch for opportunities to increase travel speed in real time, for example by dispatching incidence response units as needed.

### 5.2 Monthly, Quarterly or Annual Use

Measures tracking processes and efficiency, and those outcome measures which are expressed as ratios or averages, are typically aggregated over a period of time (often by quarter or by year, and less frequently by month). Hence, measures based on aggregated data can only be used to inform decisions at whatever frequency they are calculated and reported.

### 5.3 Decisions Affecting Organizational Performance

Measures tracking processes and efficiency can be used to identify problem areas and opportunities in organizational performance. At whatever frequency they are reviewed, process and efficiency measures can inform decisions related to organizational procedure and resource allocation. For example, an efficiency measure tracking the return-on-investment (i.e. dollars saved) from a pilot program can inform managers of whether or not to continue the program, and whether or not to expand it.

### 5.4 Decisions Affecting Systems Performance

Measures tracking systems-related outputs and outcomes are often used to inform project selection decisions. These outputs and outcomes, along with some input measures, can inform programming and budgeting. For example:

- Outcome measures related to infrastructure condition, mobility of people and freight, safety, and customer satisfaction can help identify the critical areas within the system, which are most in need of investment;
- Output measures indicate whether or not critical areas have already been addressed with treatments;
- Analyses of outcomes and outputs together can indicate what strategies have been most effective in achieving desired outcomes;
- Input measures such as dollars allocated by the state legislature and personnel available set the constraints for programming and budgeting treatments to the system.

### 5.5 Scope of Influence, Communication, and Collaboration

Sometimes the division or entire agency that collects and analyzes performance data is not the same division or agency that has the power to make decisions in a particular area. For example, Georgia DOT's performance measurement functions are located in a division that is not involved in project selection. Still more often, the implementation of performance-based decisions might depend on collaboration between multiple divisions or agencies. For example, initiatives to impact highway safety often include both the DOT and the police. In situations such as these, effective performance management will depend as much on the ease and clarity of communication between multiple divisions or agencies as it does on the integrity and relevance of performance measures. Communication and collaboration can be improved with formal reporting mechanisms and clear procedures.

## **6. Performance Management in the Organizational Structure**

### 6.1 Ownership and Accountability

Effective performance management systems have champions - staff members who take responsibility for performance measurement and performance-based action. Most of the agencies reviewed for this study mention these champions, also called "owners" or "drivers," in their performance reports. Often, each performance measure is "owned" by the specific division or office to which the measure is most relevant. Sometimes, an individual person within that division or office is listed as a contact person, someone who can answer questions and be held accountable for performance. Missouri DOT assigns a measurement driver as well as a results driver to each performance measure, and they are sometimes from different departments.

### 6.2 Balancing Centralization and Decentralization

Several of the DOTs reviewed for this study have centralized offices that are solely or primarily dedicated to performance measurement and management tasks. From agency to agency, these offices vary in size between one and seven full-time positions. Centralized performance measurement/management offices typically produce performance reports for circulation within and outside of the agency, manage performance databases for some or all of the agency's functional units, and manage internal and external dashboards. Some agencies combine performance measurement functions with strategic planning, project selection, and/or asset management in the same office. These combinations can facilitate strong connections between measures and actions since some of the same staff members are involved with both.

Whether or not a centralized office exists to handle performance reporting and other performance-management functions, certain tasks will remain decentralized throughout an agency. Namely, initial data collection, and the implementation of performance-based decisions will always be carried out at the "front lines" by various divisions and offices. Some agencies also decentralize a fair amount of decision-making power. For example, some regional or district offices have their own planning arms that make project selection

decisions, and some program- or function-specific divisions set their own strategic goals and objectives.

Ultimately, a DOT must find a balance between centralized and decentralized performance management. Some example approaches to finding this balance include:

- Building a centralized office with personnel who would otherwise be located in different divisions from each other; Minnesota DOT's Performance Planning and Measurement Unit is comprised of two analysts, an engineer, a planner, and a program administrator
- Bringing functional units together in periodic meetings to discuss performance, as with Missouri DOT's quarterly *Tracker* reviews
- Generating clear procedures and guidelines for the flow of performance management tasks; for example, Washington State DOT developed a "value stream map" of its annual budget process, illustrating how and when functional units within the agency must interact with each other, and with functional units elsewhere within state government, in order to complete the budget in an efficient and timely manner

Using an agency-wide data-management and/or decision-making tool; for example, Florida DOT uses the Efficient Transportation Decision Making (ETDM) tool, which makes information such as GIS and data sets available to the entire department for all projects.

## **7. Reporting**

Performance reporting is important in order to convey information that is relevant to multiple audiences. The format of a performance report will depend on its intended audience; for example, external government stakeholders, the public and system users or internal stakeholders such as technical staff or managers.

### 7.1 External Reporting

Most of the agencies that were reviewed for this study produce at least one external report, which is made publicly available online in portable document format (pdf). This document is typically meant to convey relevant information to the public, external government stakeholders such as the governor and state legislature, and other agency partners, although some agencies produce multiple reports to address different stakeholders. Several agencies also present performance data through an interactive website and/or an online dashboard. These websites present performance information in a primarily graphical form, whereas the downloadable report documents typically use more description and explanation. Other outlets for external performance reporting include social media, newspaper articles, and information sessions, using posters or slide presentations.

## 7.2 Gaining Credibility

Performance reports that are made available to outside stakeholders are meant to help an agency demonstrate its credibility and accountability. This is best accomplished when the agency communicates its accomplishments in areas of high performance as well as its risks in areas of concern. Many agencies are eager to report performance in areas where they are performing well, but they are hesitant to report in areas where performance is less than desired. In fact, multiple of the agencies interviewed for this study described that certain performance information was not released publicly until after it had been tracked internally for some time, and internal managers were comfortable that the agency had demonstrated desirable performance trends. This may be a prudent approach. However, an agency that reports performance in areas of concern gains the opportunity to demonstrate forethought in those areas. Once an agency can comfortably include performance information that is less than desirable in external reports, it gains the opportunity to outline strategies for improving performance, and to identify the resources needed to improve. This demonstration of forethought can help agencies to attract much-needed resources and develop credibility with its stakeholders. For example, Washington State DOT credits its quarterly performance report, the Gray Notebook (first published in 2001), with helping to build a credible case for increased funding in a short period of time; Washington voters approved two increases in the state gas tax in 2003 and 2005.

## 7.3 Internal Reporting

Several agencies report performance information internally with more detail than is released to external stakeholders. Much internal reporting is localized to an individual division or offices within an agency, while some agencies also publish agency-wide internal reports. Example localized reporting mechanisms include the division-level dashboards used by functional units within Oregon DOT, and the *D-Tracker* reports created by Missouri DOT. Oregon's division-level dashboards are updated dynamically and used for day-to-day performance management. Missouri's *D-Trackers* include quarterly and annual performance information at the division or district level. Example agency-wide internal reports include Missouri DOT's *Supplement* report and Utah DOT's *Accomplishments & Efficiencies* report. Missouri's *Supplement* compares performance across the agency's divisions and districts, allowing them to benchmark against one other. Utah's annual *Accomplishments & Efficiencies* report highlights actions by individual functional units within the agency to advance strategic goals. The *Accomplishments & Efficiencies* report has been used as the foundation to develop performance measures, and to develop articles and presentations for the public and the research community. This and other internal reports have also eventually been released externally as internal managers have become confident that the information is suitably presented for a public audience.

## 7.4 Multiagency Reporting

Some state governments have instituted performance reporting for all of their executive agencies. In these cases, DOT performance may be reported on inter-agency websites,

alongside performance information from other agencies. For example, the *Virginia Performs* website reports performance information related to transportation as well as other areas such as agriculture, education, and health. In other cases, although an executive mandate may not exist, performance information may be compiled for multiple related agencies (for example related to transportation and development) for the sake of brevity and efficiency. This is the case with Maryland DOT, which reports performance information for all of the transportation agencies in Maryland (Aviation, Port, Transit, etc.) in its *Annual Attainment Report*.

### 7.5 Dynamic Reporting

Several DOTs report system performance in real time, through online dashboards and traffic maps. Some also use social media outlets such as Twitter and Facebook to notify users about specific issues, such as road closures. Providing real-time performance information to system users provides them with the option to change their behaviors. Therefore, this sort of dynamic reporting can be seen as a transportation management strategy.

### 7.6 Graphical Elements

All the DOTs reviewed for this study portray at least some performance information in graphical form. Time series charts that show actual performance alongside numerical targets and desirable trend directions are common, as are dashboard graphics that illustrate target values using traffic light colors. Fewer agencies also include photographs, maps and diagrams in their performance reports, in order to highlight programs, projects, and other initiatives that are tangible and appealing to the public and other stakeholders.

### 7.7 Reporting Comparisons

Several of the agencies reviewed for this study incorporate some kind of comparative performance measurement (or “benchmarking”) in their performance reporting. Some benchmarking is internal to the agency; for example, Missouri DOT’s (internal) *Supplement* report compares performance among the agency’s divisions and districts. More commonly, an agency as a whole will benchmark its performance against that of peer states or the national average. Sometimes external benchmarking is not possible for a particular measure because of how data is collected or analyzed. This problem is noted by Oregon DOT, whose Annual Performance Progress Report includes a “How We Compare” section for every measure; the “use of safety belts” measure “cannot be compared to other state because... [the national] survey does not review all seats in a vehicle like the Oregon survey does.”

In agencies where performance measurement is an appreciated part of the organizational culture, benchmarking can motivate staff to increase efficiency and to try innovative approaches to performance management. For measured performance that compares well, benchmarking elicits a sense of pride in the agency’s achievements. For measured performance that compares poorly, benchmarking can provide a sense of urgency to improve. However, in an agency where much of the staff is still skeptical

about the value of performance measurement, benchmarking could demoralize staff whose measured performance compares poorly. Some of the agencies interviewed in this study expressed hesitancy to conduct internal benchmarking, in particular, for reasons related to agency culture. In such situations, comparative reporting can still be beneficial and motivating if it avoids ranking functional units and simply highlights and celebrates accomplishments instead. This sort of affirmative sharing can be done in (internal or external) published reports such as Utah DOT's *Efficiencies and Accomplishments* report, or in meetings such as Missouri DOT's quarterly *Tracker*-review meeting.

### 7.8 Multiple Spatial Scales

Some agencies provide performance information for different jurisdictions and at different spatial scales more to satisfy stakeholders' curiosity than for benchmarking. For example, North Carolina DOT's performance dashboard breaks down some of the measures by county, so that users can look at trends in their own counties. Likewise, some agencies have district or regional offices that produce their own performance reports; examples are Utah DOT's Region 4 *Performance Model* and Region 2 *FACTS*, and Missouri DOT's *D-Tracker* reports.

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## IV. Maturity Model and Self-Diagnostic Tools

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## 1. Background and Methodology

Two of the primary deliverables of this project are an Organizational Performance Management Maturity Model and an associated Diagnostic Self-Assessment Tool. The model and tool were developed and refined in tandem, based on knowledge acquired from the literature review, repeated review by an expert panel, and interviews with DOT representatives.

### 1.1 From Generations to Stages of Maturity (Literature Review)

The initial concept for a maturity model of transportation agency performance management is based on the “generational framework,” which was first defined by Bremmer et al. (2005) and then expanded through the literature review associated with this project. The generational framework summarizes how performance measurement and management practice has evolved over time at U.S. transportation agencies. However, this historical perspective does not offer explicit guidance to a transportation agency seeking to build, maintain, or enhance its performance management program. Rather, some of the characteristics mentioned in the generational framework do not reflect desirable performance management practice. For example, generation 1 is characterized by “siloes” performance measurement and decision making, and generation 2 is characterized by “a proliferation of measures... [that] are often complex and difficult to communicate.” To transform the generational framework into a model for maturity, the research team identified and organized the desirable characteristics of performance management programs into four “stages” of maturity:

Stage 1: Emerging performance measurement

Stage 2: Advanced performance measurement

Stage 3: Emerging performance management

Stage 4: Advanced Performance management

An early version of the maturity model included 32 characteristics of performance management, in 7 categories. Each criterion was loosely assigned to a stage of maturity based on the “generation” during which it seems to have first emerged in practice.

### 1.2 From one Model to two Tools (Expert Panel)

A panel of experts representing government, industry, and academia was convened by conference call in March 2012 to review the first version of the maturity model and provide extensive feedback. It was during this conversation that the idea for a self-diagnostic tool emerged. The panel observed that the exact make-up of an effective performance management program depends on the unique decision-making context that it serves. Therefore, the self-diagnostic tool was proposed to be interactive, helping an agency to identify ways to enhance its performance management program within the context of its own strategic goals, objectives, and important stakeholders.

The Georgia Tech research team began to develop a spreadsheet-based tool based on the expert panel's suggestions. The expert panel convened a second time by conference call in April 2012 to review a first draft of this diagnostic tool. During this second meeting, the panelists observed that some DOT managers may be hesitant to use the tool because of its in-depth nature, which takes a time commitment of one hour or more. Therefore, they suggested that a second product, with a shorter time commitment, be developed to give managers ideas to enhance performance management.

Based on the expert panel's second round of suggestions, the Georgia Tech team developed two products that can be used by DOTs:

- Executive Checklist: A tool that is meant to be reviewed quickly, within approximately ten minutes. The checklist is based on a finalized maturity model for successful performance management, allowing DOT managers to evaluate their existing PM programs in general.
- Self-Diagnostic Tool: A spreadsheet-based tool that DOT staff members can use to define the agency's context, evaluate its existing performance management program, and identify specific steps for enhancing the program. This tool can be customized to analyze the PM program of an entire agency, or that of an individual division, bureau or office within the agency. It can also be used to enhance various aspects or elements of performance within any particular unit.

### 1.3 Refining the Model and Tools (Case Study Interviews)

Since the maturity model and self-assessment tools are explicitly linked, they were refined together. To calibrate the self-diagnostic tool, the research team conducted interviews with representatives from ten state DOTs. The ten agencies were selected based on recommendations from the expert panel. All of the interviewees held coordinating roles for performance management in their respective agencies. In the interviews, interviewees used the diagnostic tool and provided feedback about ease of use and relevance to their performance management programs.

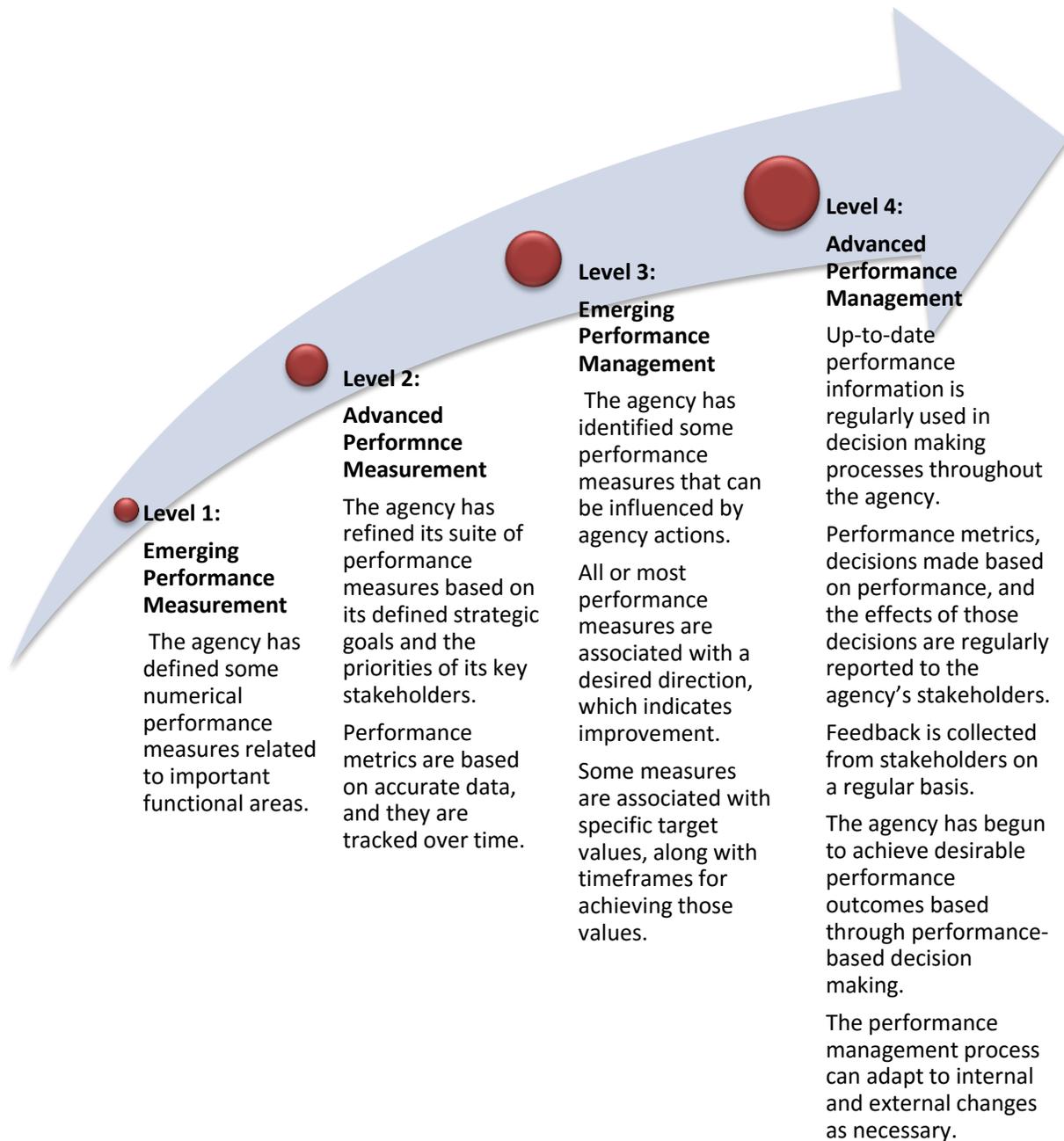
Both the Executive Checklist and the Self-Diagnostic Tool are designed to be used by an individual or small team that is familiar with the agency's performance management program. While the checklist is meant to be reviewed quickly, within approximately ten minutes, the diagnostic self-assessment tool is much more in-depth and may take an hour or more. In this sense, the checklist is similar in function to AASHTO's Systems Operations & Management One-minute Guidance Evaluation, whereas the interactive tool is akin to AASHTO's associated Customized Guidance Evaluation ([www.aashtosomguidance.org/](http://www.aashtosomguidance.org/)). Another similar product is the self-assessment evaluation in AASHTO's Transportation Asset Management (TAM) Guide (<http://downloads.transportation.org/AMGuide.pdf>). The maturity model and self-assessment tool from this study differ from the AASHTO products because of this study's focus on organizational and systems performance management, which is broader than either asset management or systems operations and management.

## 2. Complete Maturity Model and Executive Checklist

**Table 2: Maturity Model for Organizational Performance Management**

Performance Management Areas and Characteristics	Levels of Maturity			
	Measurement		Management	
	Emerging 1	Advanced 2	Emerging 3	Advanced 4
<b>Designing / Selecting Performance Measures</b>				
Measures are numerical	x	x	x	x
Measures relate to agency functions	x	x	x	x
Measures relate to strategic goals (vertical integration)		x	x	x
Measures relate to the priorities of key external stakeholders		x	x	x
Measured values can be affected by agency actions			x	x
<b>Collecting and Managing Data</b>				
Measures are supported with data	x	x	x	x
Performance data are accurate and consistent		x	x	x
Performance data are updated regularly			x	x
Performance data are readily available for analysis				x
<b>Tracking Achievement</b>				
Performance values are tracked over time	x	x	x	x
Measures are associated with desired directions (trends), which indicate improvement			x	x
Target values are set, as necessary, to guide short-term achievement toward long-term goals			x	x
Target values and timeframes are based on funding projections and technical ability				x
When possible, performance is benchmarked against peer agencies and prevailing trends				x
<b>Organizational Processes</b>				
The agency has dedicated resources and defined champion(s) for performance measurement and/or management		x	x	x
In general, agency employees agree that performance measurement and/or management is important			x	x
Measures and targets are regularly reviewed, and adjusted as necessary to meet new needs			x	x
Performance information is used during resource allocation				x
Performance information is tracked for and used by functional units throughout the agency				x
Different functional units share performance information with each other when necessary, using existing formal mechanisms (horizontal integration)				x
Multiple functional units collaborate on performance outcomes, as needed, through formal mechanisms (horizontal integration)				x
<b>Reporting &amp; Feedback</b>				
External stakeholders can access updated performance information easily (at least annually for most measures)			x	x
Performance information is made available to the public in multiple ways and is easy to find			x	x
Reporting tools are visually appealing and easy to understand (effective use of graphics and writing)			x	x

Reporting tools relate performance outcomes to agency actions				x
Performance management tools and processes are periodically adjusted based on stakeholder feedback				x



**Figure 1: Levels of Maturity Characterized by the Maturity Model**

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# Leading Practices in Organizational and Systems Performance Management in State DOTs

## Volume I: STATE DOT BENCHMARKING STUDY

### Appendix A: COMPLETE LITERATURE REVIEW

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Project Title  
**Transportation Asset Management: Organizational Performance and Risk Review**

Submitted to  
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**Table of Contents**

Working Definitions	A3
Glossary	A4
List of Tables and Figures	A5
<b>I. Foundations of Performance Management</b>	A6
1. Introduction to Performance Management	A7
1.1 MAP 21 and Performance-Based Planning	A7
1.2 Performance Management	A7
1.3 Evolution of Performance Management in U.S. Transportation Agencies	A12
2. Organizational Structure for Performance Management	A17
2.1 Leadership and Management Structure	A17
2.2 Employee Accountability	A18
2.3 Distribution of Responsibility	A19
<b>II. Processes for Performance Management</b>	A21
3. Performance-Based Strategic Planning	A22
3.1 Linking Policy with Project Programming and Budgeting	A23
3.2 Performance Measurement	A24
4. Performance Measurement	A24
4.1 Selecting Performance Measures	A26
4.2 Example Frameworks for Principled Performance Measurement	A28
4.3 Example Measures in Important Goal Areas	A35
4.4 Collecting and Managing Performance Data	A38
4.5 Setting Performance Targets	A41
5. Funds Allocation and Programming	A41
5.1 Performance-Based Policy for Decision Making and Funds Allocation	A42
5.2 Funding Allocation in the Performance Management Framework	A44
6. External Reporting and Communication	A44
6.1 Principles of Data Presentation for Effective Communication	A45
6.2 Reporting Styles	A52
7. Performance Management Best Practices and Lessons Learned and Linkages with Asset Management	A54
7.1 International Best Practices in Performance Management	A55
7.2 Current Practice in State DOTs	
References	A57

## Working Definitions

Organizational Performance	An organization’s performance in relation to its goals and objectives. [BusinessDictionary.com]
System Performance	The degree to which a system serves its users and fulfills the purpose for which it was built or acquired as measured by the accumulated quality and length of service that it provides to its users. [Hudson et al., 1997, p.167]
Performance Measurement	The ongoing monitoring and reporting of program accomplishments, particularly progress toward pre-established goals. [US Governmental Accounting Office as quoted in “Linking Performance and Accountability Scan Report, FHWA /AASHTO, 2010]
Performance Management	<p>Performance Management is an ongoing, systematic approach to improving results through evidence-based decision making, continuous organizational learning, and a focus on accountability for performance. [Kane (AASHTO Director for Engineering and Technical Services), 2010]</p> <p>Performance Management is the regular ongoing process of selecting measures, setting targets and using measures in decision making, and reporting achievement, leading to the development of a culture of performance throughout the agency. ... It involves the successful application of performance data to manage agency performance toward achieving agency strategic goals consistently. [NCHRP 666, 2010]</p> <p>Ongoing process that translates strategic goals into relevant and detailed measures and targets which, along with resources, are continuously monitored to ensure achievement of published institutional goals. [AASHTO - as defined in “Linking Transportation Performance and Accountability” Scan Report, FHWA/AASHTO, p.11]</p>
Strategic Planning	Strategic Planning is defined as the systematic process of envisioning a desired future, and translating this future into broadly defined goals and objectives and a sequence of steps to achieve them. [BusinessDictionary.com]
Strategic Management	Managing an agency’s strategic agenda on a continuous rather than episodic basis, and linking the strategic agenda to resource management. [Bryson, J. M. A Strategic Planning Process for Public and Non-Profit Organizations, Long Range Planning, Vol. 21, No. 1, pp. 73-81]
Asset Management	<p>Asset Management is the combination of management, financial, economic, engineering and other practices applied to physical assets with the objective of providing the required level of service in the most cost effective manner. [AASHTO TAM Implementation Guide, NCHRP/AASHTO, 2011]</p> <p>Asset Management is the strategic process of operating, maintaining, upgrading and expanding physical assets effectively throughout their lifecycle. [AASHTO Transportation Asset Management Strategic Plan, 2011-2015]</p>

## **Glossary**

AASHTO	American Association of State Highway and Transportation Officials
ISTEA	Intermodal Surface Transportation Efficiency Act (1991)
TEA-21	Transportation Equity Act for the 21 <sup>st</sup> Century (1998)
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Act: A Legacy for Users (2005)
MAP-21	Moving Ahead for Progress in the 21 <sup>st</sup> Century (2012)
USDOT	United States Department of Transportation

**List of Tables and Figures**

<b>Tables</b>	<b>Titles</b>	<b>Page #</b>
1	Types of Performance Measures	A10
2	Example organization of performance measures from Louisiana DOTD	A26
3	Example of a Completed Eastman Kodak Performance Matrix	A40
4	Options for Linking Performance to Funding Allocation	A44
<b>Figures</b>	<b>Captions</b>	<b>Page #</b>
1	Performance Management Framework	A6
2	The Performance Management Process	A7
3	Federal Legislation Impacting Transportation Performance Measurement and Management	A10
4	Evolution of Performance Management Frameworks of State Transportation Agencies (~1990-2010)	A14
5	Flow of Responsibility at Kansas DOT	
6	NCDOT "Policy to Projects" Framework	A21
7	FDOT Performance Measures Framework	A22
8	Florida DOT "Continuous Cycle of Improvement"	A23
9	Example of the Balanced Scorecard Framework from Texas DOT	A27
10	The Stakeholder-Focused Performance Prism Model	A28
11	Minnesota DOT's Performance Target Levels	A40
12	Florida DOT's "Measurable Objective: Pavement Condition"	A40
13	Screenshot of the ODOT Performance Dashboard website	A47
14	Screenshot of TxDOT Tracker Website	A4
15	GDOT Performance Management Dashboard	A48
16	Screenshot from Caltrans' "Key Dashboard Performance Indicators,"	A49
17	Screenshot of the time series chart that corresponds to the dashboard graphic in Figure 16	A49

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## **I. Foundations of Performance Management**

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# 1. Introduction to Performance Management

## 1.1 Federal Surface Transportation Act: MAP-21 & Performance-Based Planning

In July 2012, the President of the United States signed into law P. L. 112-141: *Moving Ahead for Progress in the 21<sup>st</sup> Century* (MAP-21). MAP-21 funds surface transportation programs at over \$105 billion for FY 2013 and 2014, and transforms the policy and programmatic framework to a performance-based, multimodal approach to guide investments in the nation's vital transportation infrastructure for growth and development. The cornerstone of MAP-21's program transformation is a performance-based and outcomes-based program, and it introduces performance management as a framework for guiding the achievement of national strategic goals. MAP-21 establishes seven national performance goals for federal highway programs. Requirements for a long-range plan and short-term transportation improvement program (TIP) continue; however, there is an additional requirement for the long-range plan to include performance measures and targets to be used in assessing system performance. Performance goals have been established in the following areas:

*Safety* – To achieve a significant reduction in traffic fatalities and serious injuries on all public roads

*Infrastructure condition* – To maintain the highway infrastructure asset system in a state of good repair

*Congestion reduction* – To achieve a significant reduction in congestion on the *NHS*

*System reliability* – To improve the efficiency of the surface transportation system

*Freight movement and economic vitality* – To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development

*Environmental sustainability* – To enhance the performance of the transportation system while protecting and enhancing the natural environment

*Reduced project delivery delays* – To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices [1].

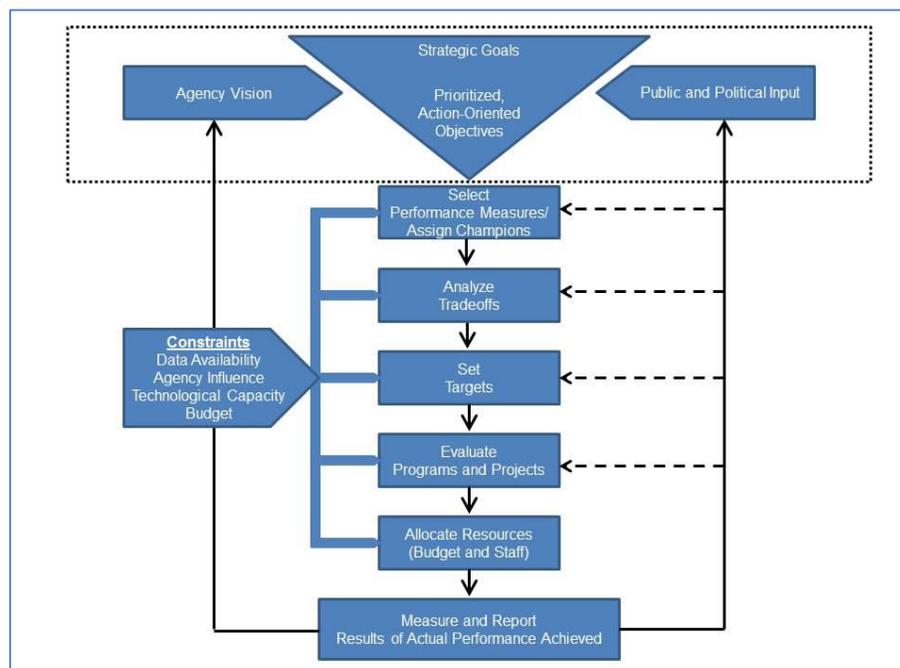
## 1.2 Performance Management

MAP-21 formalizes an ongoing evolution from performance measurement to management that has been occurring in state Departments of Transportation (DOTs) for the last several years [2, 3, 4]. As defined by AASHTO's Director for Engineering and Technical services, performance management is an ongoing, systematic approach to improving results through evidence-based decision making, continuous organizational learning, and a focus on accountability for performance [5]. Over several decades,

performance concepts have been applied in transportation decision making to help achieve more effective and efficient outcomes. Such practice involves applications of performance measurement, strategic planning, strategic management, transportation asset management and performance-based decision making. Performance management is good business practice. A scan tour sponsored by the USDOT and AASHTO on the linkages between performance and accountability showed that six roadway and transportation agencies in Sweden, Australia, New Zealand and the U.K., each with over 10 years each of experience in performance management (PM), have demonstrated that PM is a good business approach for achieving steady increases in program effectiveness in the long term. In particular, the best practice agencies identified the real value of performance management as improved decision making and investment process, in the long term, rather than the achievement of many arbitrary, short-term targets [6].

*1.2.1 Key Elements of a Performance Management Framework*

The business practice of performance management (PM) integrates several of the traditional activities of a transportation agency, including coordination of various plans and programs into a framework to make data-driven decisions for achieving the outcomes that are important to the agency and its stakeholders. Such activities may include long-range planning, project prioritization and programming. PM is concerned with managing organizational performance to achieve agency strategic goals. In a state DOT, organizational performance and systems performance are closely linked because the mission of the agency largely involves managing highway or multimodal transportation systems. Figure 1 depicts basic elements of performance management.



**Figure 1: Performance Management Framework**

*1.2.2 Key Processes of Performance Management*

Another way to view the business practice of PM is as a cycle of interlinked processes, associated with the development and use of performance information [3, 7], as follows:

1. Formulate performance measures to support an agency's strategic goals and objectives;
2. Collect, manage and analyze data in terms of the formulated performance measures;
3. Use performance information in decision making to design new programs or projects, and to periodically set new goals, objectives and targets.
4. Track and report performance information to political decision makers, stakeholders and peers, in order to determine and demonstrate progress towards performance objectives and targets.

Figure 2 illustrates the cyclical relationship between these key PM processes.



**Figure 2: The Performance Management Process [Adapted from 3, 7]**

*1.2.3 Key Characteristics of Performance Management*

Implicit in the processes described above are several key characteristics of PM, which distinguish between performance *measurement* programs and more comprehensive and maturing performance *management* programs. Performance measurement involves determining how best to measure activities, processes and outcomes, and collecting and analyzing data to do so. The US Government Accounting Office defines performance measurement as the ongoing monitoring and reporting of program accomplishments, particularly progress toward pre-established goals. The Federal Highway Administration (FHWA) defines performance measures as quantitative or qualitative indicators of system effectiveness and efficiency, including cost effectiveness [9]. Input, output, outcome and efficiency measures are all necessary for capturing different aspects of organizational and system performance (Table 1).

**Table 1: Types of Performance Measures [Informed by 9]**

<b>Type of Measure</b>	<b>Definition</b>	<b>Examples</b>
Input	Measures available resources for accomplishing work. E.g., Measures of labor, equipment and cost inputs for accomplishing work.	Number of trained operators per truck; number of trucks
Output	Measure work accomplished. Measure what has been directly achieved.	Number of lane miles of roadway resurfaced
Outcome	Measure impact of work accomplished on system users.	Change in customer satisfaction (with respect to the ride quality of resurfaced roadways)
Efficiency	Measure of inputs with respect to outputs or outcomes.	Cost-effectiveness of work, i.e., change in customer satisfaction index per unit maintenance expenditure; Work efficiency measures, e.g., Number of lane miles of road resurfaced per unit of time and labor.

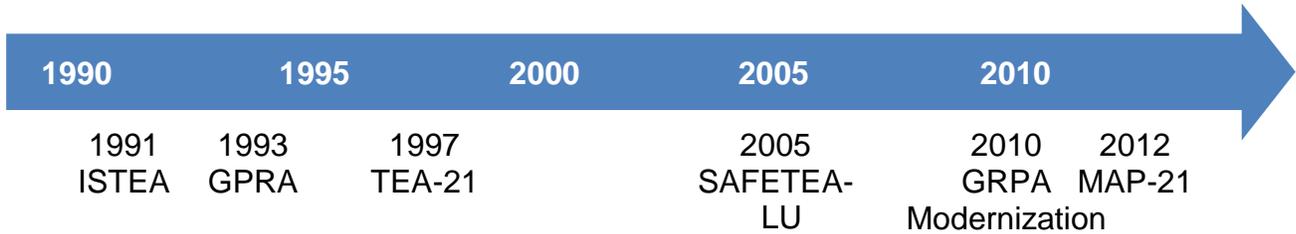
Performance management, on the other hand, is about crafting good metrics to achieve desired strategic goals outcomes; which includes tracking the performance measures collectively and using them to manage agency decision making to accomplish strategic goals. Thus, performance measurement is only one of several elements of performance management.

1.3 Evolution of Performance Management in U.S. Transportation Agencies

Until as recently as 2010, it was rare to hear the term “performance management” in a transportation context. Nonetheless, Federal legislation and AASHTO initiatives over the past two decades show evidence of a gradual movement from measuring to managing performance. The three funding reauthorizations for surface transportation (ISTEA, TEA-21 and SAFETEA-LU) prior to MAP-21, and two Government Performance and Results Acts (GPRA), all include elements of performance measurement and performance-based decision making. These five Acts are shown in a timeline in Figure 3.

In addition, the AASHTO Standing Committee on Performance Management (SCOPM), formed in 2008, has developed an Action Plan (2011-2014) identifying focus areas for performance implementation over the next three years. Over this period, U.S. transportation agencies have expanded their suites of performance measures and to link

performance management concepts to other agency processes such as strategic planning and asset management. The 2012 reauthorization of the Federal Surface Transportation Program, MAP-21, can be viewed as an important step in formalizing continuing efforts in a national policy for performance-based transportation decision making.



**Figure 3: Federal Legislation Impacting Transportation Performance Measurement and Management (1990-2012)**

*1.3.1 From Performance Measurement to Performance Management*

Transportation-related performance measures have been used in the U.S. for several decades. For example, the 2<sup>nd</sup> (1965) edition of the Highway Capacity Manual first introduced the grading concept for level of service (LOS A-F) [10]; measures of bridge health became widely used after Congress established the National Bridge Inspection Program in response to the deadly collapse of the Silver Bridge in 1967 [11]; and the pavement condition index (PCI) was formulated by the U.S. Army Corps of Engineers in 1978 [12]. Measures such as these that deal with traffic operations and physical assets, are still among the performance measures most widely used at State DOTs. The list of measures has since expanded, though, as performance-based decision making has become more important in other agency processes. A fully integrated performance management system at a transportation agency will use a wide range of performance measures corresponding to the strategic objectives of the agency, and to different agency processes, inputs, outputs and outcomes (all related to the agency’s strategic objectives).

**I. Performance-Based Strategic Planning and Management**

Adopted from the private sector in the mid-1970s, strategic planning has been applied in the transportation sector in order to incorporate an interactive and continuous quality improvement approach to decision making [13]. Strategic Planning is defined as the systematic process of envisioning a desired future, and translating this future into broadly defined goals and objectives and a sequence of steps to achieve them [14]. Bryson (1998) defines strategic planning in the context of the public sector as a disciplined effort to produce fundamental decisions and actions shaping the nature and direction of an organization’s activities within legal bounds. It is designed to help agencies respond effectively to new or changing situations (in reference to their external and internal environments) [15]. Strategic planning is used to guide policy and investment decisions based on future goals and past performance. It is a continuous process that incorporates the consistent feedback of performance outcomes into future planning [16], and as such

it serves as the vital connection between organizational performance outcomes and agency decision making. Through the use of performance measurement, feedback can be obtained on the effectiveness of past strategies to reach agency strategic goals and inform future decision making. Bryson contrasts strategic management with strategic planning indicating that strategic management is managing an agency's strategic agenda on a continuous rather than episodic basis [15]. This implies that when an agency moves from strategic planning to strategic management, it is likely to have up-to-date strategic goals relative to its internal and external stakeholders at any point in time.

## II. Performance-Based Asset Management

In 1996, FHWA and AASHTO sponsored a "first-of-its-kind" seminar on transportation asset management (TAM). For that meeting, TAM was defined as "a systematic process of maintaining, upgrading, and operating physical assets... in a cost-effective way" [17]. Although performance measures related to pavements and bridges had been in use in the U.S. for decades, this seminar was organized to help transportation agencies start "casting the net widely," to begin managing other physical assets and to draw from the experience of the private sector. At the seminar, participants heard from Wal-Mart and the U.S. Air Force about the importance of managing real estate investments; from GTE Laboratories about responding to customer needs; and from the Port Authority of New York and New Jersey about projecting fiscal constraints. The report published on the seminar describes "next steps" for TAM such as "inventory, condition assessment, and an asset evaluation; performance prediction measures and trend indicators; cost estimates of asset management options and resulting impacts; and engineering/economic optimization tools [17]."

Although the 1996 TAM seminar and its accompanying literature did not expressly mention the term "performance management" many of the principles and processes explored are closely related. In fact, "a policy-driven, performance-based approach to resource allocation... has been cast as the foundation of transportation asset management. In other words, the effectiveness of a TAM program will depend on how well an agency implements the processes and principles of PM with respect to monitoring and maintaining physical assets. With this in mind, the practices of "performance-based" TAM can be summarized in the following three points [19]:

1. Formulating performance measures and targets for physical assets that can influence outcomes related to the agency's strategic goals and customer needs.
2. Periodically updating long-term projections of asset condition, associated performance, and costs.
3. Evaluating tradeoffs between alternative investment options, with respect to desired outcomes.

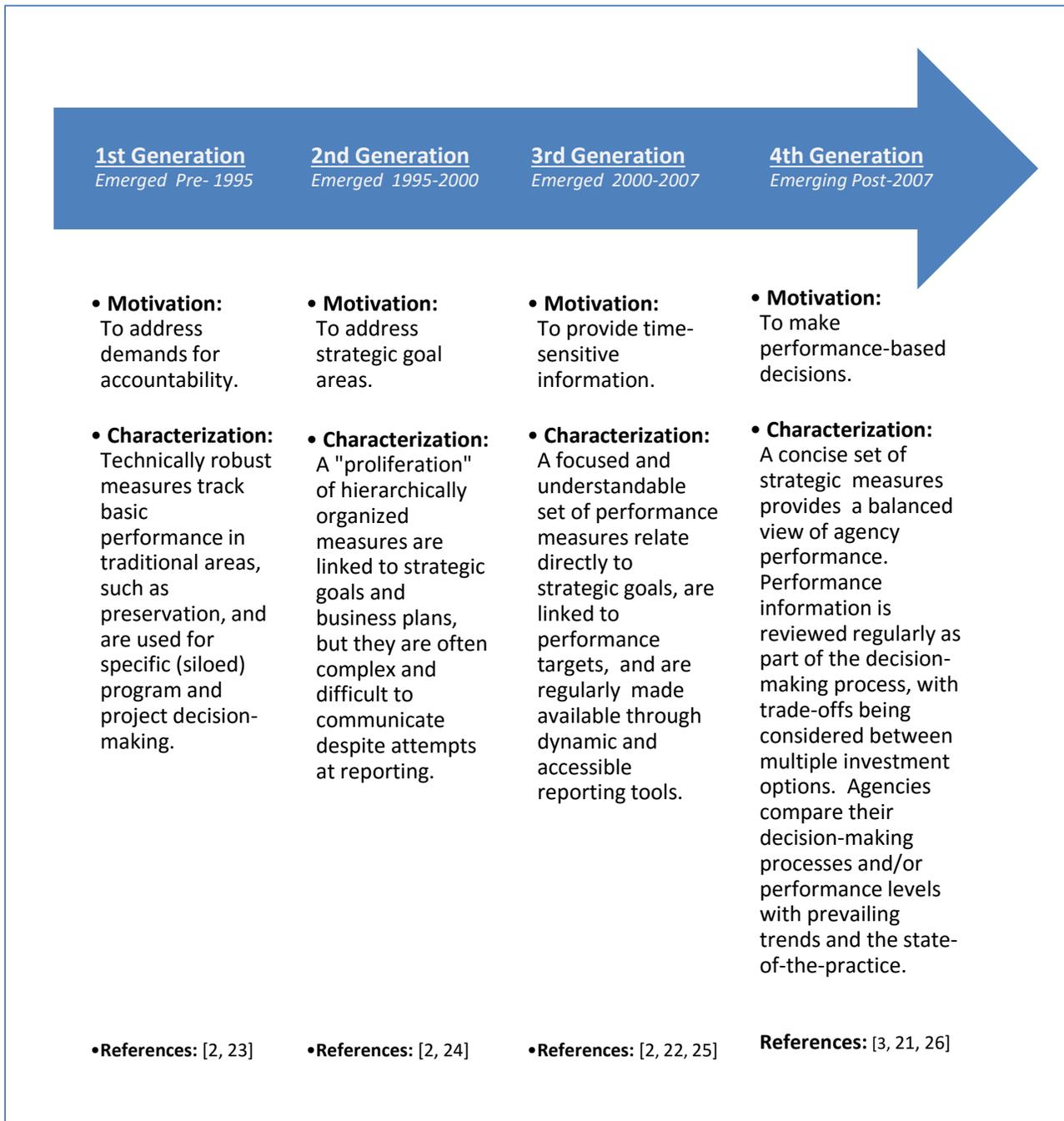
For example, one strategic goal of a transportation agency might be to increase safety. A relevant outcome-oriented performance target might be to decrease crash rates by a certain percentage over a certain period of time. Relevant output-oriented performance

measures and targets could relate to the roadway assets which discourage certain types of crashes. Two such output-oriented performance targets may set a minimum percentage of road-miles of certain types with guardrail and/or raised medians, as well as a minimum condition level for guardrails and raised medians. To achieve these targets, the agency would need inventories of all road-miles by type, and inventories and condition data for all guardrails and raised medians. The agency could then use this information to make investment decisions.

In order to demonstrate the effectiveness of its actions in achieving strategic goals, an agency can track and report associations between multiple performance measures. For example, an agency has direct influence over pavement condition, but its influence on safety is indirect due to factors such as driver behavior. If the agency can show that improvements in PCI are associated with improvements in safety (such as decreased crash rates), then this is evidence that their approach to safety is working. However, if such an association is not found, the agency ought to consider investing in another program that will have more influence on safety.

### III. Generations of Performance Measurement and Management

In 1993, the Government Performance and Results Act (GPRA), was passed at the Federal level to encourage performance-based decision making in all U.S. governmental agencies. More recently, the GPRA Modernization Act of 2010 refined the requirements of the original act, promoting the use of performance measures and data to drive budget and policy in both the executive and legislative branches [19]. During the nearly two decades between the original and updated GPRA, U.S. state DOTs began adjusting to a performance-based decision-making model. By 2003, according to a national survey conducted by Washington State DOT, three “generations” of development could be observed among the PM practices at state DOTs [20]. Figure 1 below summarizes and expands upon this generational framework, linking it to other observations from the transportation performance measurement and management literature from 1990-2011, and introducing a proposed fourth generation based on the results of a survey conducted on behalf of Georgia DOT in 2009-2010 [21]. The timeline in Figure 4 shows when each generation of performance measurement/management practice emerged, not the state of the practice per se at each point in time. According to a December 2010 report by the U.S. Governmental Accountability Office (GAO), “only a select few states have made significant attempts to integrate performance measurement into their statewide planning process to inform investment decisions” [11]. The 3<sup>rd</sup> and 4<sup>th</sup> generation frameworks demonstrate a transition from the prevailing concept of performance measurement to the emerging “performance management” concept.



**Figure 4: Evolution of performance measurement and management frameworks at state transportation agencies from approximately 1990-2010 [2, 3, 20, 21, 22, 21, 24, 25, 26]**

## 2. Organizational Structure for Performance Management

The entire agency must function as a unit to ensure that its performance is recorded accurately, analyzed thoroughly, and used to work towards agency-wide goals. It is critical to distribute this responsibility across the staff in an organized, efficient way that encourages horizontal collaboration and communication to maintain a successful performance management program. Once responsibilities are delegated, it is important to keep staff motivated and ensure that they fully recognize the value that their work brings to agency-wide performance. Finally, all staff must be held accountable for their contribution to the performance management program to foster a desire to improve. [3, 19, 21, 25, 10, 28]

### 2.1 Leadership and Management Structure

Initial leadership from executive and senior-level managers has proven to be essential to the success of a program in its beginning stages. Strength of leadership can be established as management participates in the process of developing and implementing the program, views the program at a micro and macro level, and provides resources to support the program. Strong leadership is also necessary from the agency's chief executive or senior management to support and cultivate the program during implementation; however, application of a performance management program cannot be fully dependent on specific leadership. It must be capable of adapting to changes in management and transitioning between management and therefore it is important to craft a policy-neutral program that can survive changes in leadership and institutionalize performance management within the agency [3].

Although it is important for management to demonstrate that performance-based decision making is a priority in an agency, implementing a performance management program cannot be accomplished through a top-down directive alone. Rather, it is also important for non-executive staff to take on leadership roles in the program; this will help to keep the program viable when top-level staff shifts to different roles or positions [10]. Leadership at multiple levels within the agency can encourage wider commitment to and acceptance of performance management among the agency's employees by giving creating a sense of ownership and an understanding that their contributions matter to agency-wide performance [4]. The lower-tiered employees should be educated on the measures and targets associated with their work. This can help provide context to connect specific skills to performance outcomes [4]. Ultimately, performance management must be embraced by the organization as a whole, and this may involve a change in agency culture.

As employees undergo training (informal or formal) in performance management, an authority structure must be in place that supports performance management. Different agencies have various structures. Kansas DOT, for example, uses a hierarchal approach that has created an executive staff at the Division Director level whose responsibility is to guide the strategic direction towards improved performance. Key senior-level managers work under the Division Directors and oversee day-to-day activities that support performance measurement [4]. Alternatively, Ohio DOT has a central office dedicated to the start-up of the performance management program, technical support, coordination, reporting, and ensuring staff awareness of the program. Responsibilities for data collection and analysis, quality control, and decision making are distributed throughout the rest of the organizational structure. Although a centralized management office does create high visibility within the agency, it could, however, impress upon lower-tiered staff that performance management is not their responsibility and make it difficult to continue the program through administration changes [10]. Minnesota DOT is another example of a successful use of the decentralized approach. They use data management systems that are maintained within individual units responsible for data quality, analysis, and reporting. Each unit reports to a central unit within the Planning Office, which is responsible for overall support of the program [10]. Evidence from a Performance Management Benchmarking Study, conducted as part of this study indicates that multiple different leadership and management structures are proving to be effective for PM.

## 2.2 Employee Accountability

To create accountability within the program, it is first essential that reasonable, achievable targets are set by incorporating performance measurement practices into existing processes. Creating a small set of priority measures that can be quickly implemented, learning through the process, and building on success by eventually adding more measures over time has proven to be a successful approach to beginning a performance management program [10]. This is not necessarily a recommendation for a large set of measures, but rather for starting small and building a focused, streamlined and understandable set of measures directly related to agency strategic goals (Figure 4).

The most successful performance management programs foster a culture of performance within the agency, among employees at all levels, and across divisions [21]. The program should be an agency-wide effort to eliminate silos and encourage horizontal collaboration [3, 16]. Employees assigned a championship role for meeting targets may not be the decision makers, therefore, it is important that all employees are aware of the purpose, goals, and procedures of the program, are kept informed on changes, have access to support functions for the program, and are invested in the performance of the transportation system. Additionally, when data is available internally at many levels of the agency, accountability is improved and employees have access to this data for short-term decision making to support a performance-based culture through regular use of performance data [3].

It has been shown that when arenas are created for employees to showcase their efforts and performance successes it helps encourage creative problem solving and

motivates all of the staff. The Ohio DOT holds an annual event called Team Up ODOT, which allows teams to present their work and serves as a way to recognize effective work [21]. Some agencies are using performance measures as part of the employee review process because individual staff development reinforces the achievement of agency goals [10]. The Ohio DOT incorporates system-wide performance measures into its personnel reviews for senior managers. The measures are carefully selected by the employees and management together, and the managers' contributions to system performance are evaluated. This has helped foster teamwork in the selection of the measures to evaluate and has encouraged managers to look for ways that they can improve performance system-wide [3]. Integrating performance measures into daily routine activities and tying system performance into employee reviews can also assist in fostering a performance-based culture [3]. Linking staff performance to agency goals, however, can only occur once the structure of the performance management program uses defined goals, measures, and targets [28]. This approach, though controversial, can help employees to see how their work contributes to the agency's ultimate goals [3]. It must however be used with caution and recognition of the limits of the agency's influence with respect to achieving certain outcomes.

### 2.3 Distribution of Responsibility

It is recommended that agencies decentralize the responsibilities of collecting and analyzing data while taking staff expertise into consideration. A decentralized approach helps to ensure accuracy by taking advantage of staff's ability to recognize inconsistent or inaccurate measurements in data that are familiar to them. Additionally, however, a centralized review process for the analysis of measurement results can help maintain consistent quality of data throughout the agency. For example, Minnesota DOT reports all information to a central unit in the Planning Office [10]. Kansas DOT also creates a hierarchy of staff responsibilities in order to engage staff at all levels in performance management activities, as shown in Figure 5.

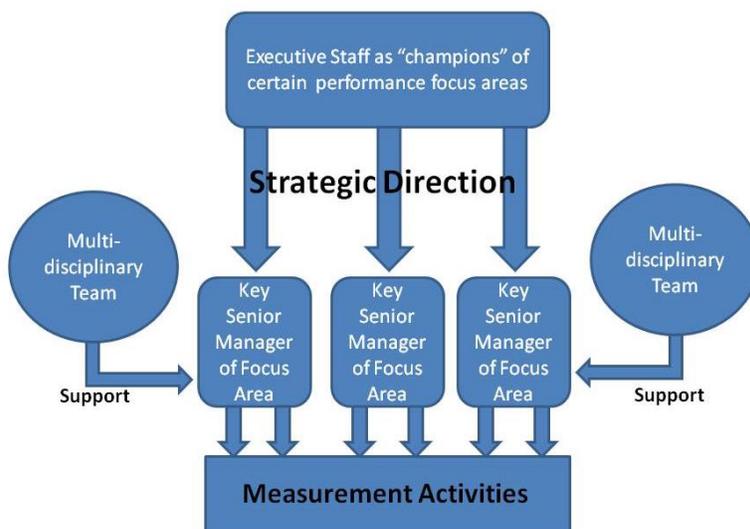


Figure 5: Flow of Responsibility at Kansas DOT [Adapted from 3]

Communication and transparency between those collecting the data and those analyzing it will help provide accountability. For example, Virginia DOT posts all performance measurement data on their public website in the same form as it was provided to them by the collectors, including any errors that may have occurred during collection. The possibility of public exposure of errors ensures that collectors are careful to take accurate measurements. Those who are responsible for the data therefore have a higher level of accountability. This full disclosure policy led to an increase in VDOT’s accuracy from about 15% to more than 65% in three months in 2006 by motivating staff to provide higher quality data and by placing the responsibility of providing the data close to those collecting and maintaining it [10]. In general, performance reporting and transparency creates incentives for staff to improve performance [3]. Many DOTs that are leaders in Performance Management report results at least on a quarterly basis [10]. Regardless of the audience (external or internal), regular reporting keeps the focus on performance fresh in the minds of staff members year round.



## **II. Processes for Performance Management**



### 3. Performance-Based Strategic Planning

Strategic planning employs an interactive and continuous approach to the management of agency policies and funds. It is an approach to decision making that uses past as well as desired outcomes to guide future policy and investment decisions. The process of strategic planning is adopted from the private sector and was first applied to the field of transportation in the mid-1970s [13]. In the private sector, profit levels and returns-on-investments provide feedback on results of the plan implementation; however, as the public sector, and more specifically transportation agencies, adopts strategic planning, feedback is obtained through performance measurement [16]. Over time, the federal transportation legislation has begun to require agencies to monitor performance measures. The 1991 reauthorization (ISTEA) established performance monitoring for transportation on a national level through the creation of six management systems: pavement, bridge, highway safety, traffic congestion, public transit facilities and equipment, and intermodal management systems [29]. In another federal legislation, this time across all agencies, the Government Performance and Results Act was passed in 1993 “to provide for the establishment of strategic planning and performance measurement in the Federal Government, and for other purposes [30].” In 1997, the transportation funding reauthorization (TEA-21) further supported the inclusion of performance measures in transportation planning stating, “The growing importance of operating and managing the transportation system is recognized as a focal point for transportation planning [13].” These activities can be viewed as important milestones in the general movement toward performance-based strategic planning.

However, neither the use of performance measures nor the development of a strategic plan alone constitutes strategic planning. Strategic planning is a continuous process that requires consistent feedback of performance outcomes into future planning [16]. The key principle of strategic planning is the connection of the performance measures back to the strategic plan. This is also the central principle of performance management. In this way, effectively implementing strategic planning can essentially be viewed as the fourth generation of performance measurement and management.

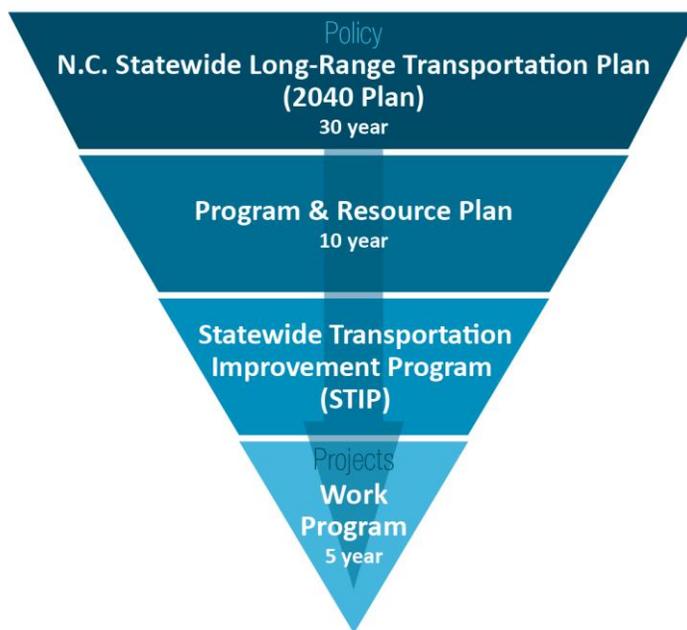
Through strategic planning, agencies determine organizational goals and establish annual performance targets for the agency’s strategic business plan. These goals and targets will direct their future decisions [31], and influence all aspects of their decision making, including the state transportation long-range plan. The long-range plan is a key step in establishing a performance-based management program [32], where an agency has control over project selection. A long range-plan characterizes current system-wide or subnetwork performance, defining long-term system condition and service objectives, analyzing the impacts of different investment levels or strategies, and estimating investment needs associated with alternative performance levels [31]. It is used to guide project selection to achieve articulated performance targets. Progress towards achieving long-range goals starts with establishing a baseline, setting targets for improvement, and generating performance measures to gauge progress [25]. It is therefore critical to implement appropriate performance measures and use them to track progress and influence decision making to achieve desired outcomes.

Volume I Appendix A: Complete Literature Review

3.1 Linking Policy with Project Programming and Budgeting

One challenge agencies face is reporting on an appropriate number of measures. Agencies may either report a limited number of activities that have minimal impact on system performance or, conversely report on hundreds of activities or outcomes that lack cohesion. The appropriate number of measures is a key difference between agencies in the second and third generation of performance management. Performance measures are discussed further in section 4 of this report.

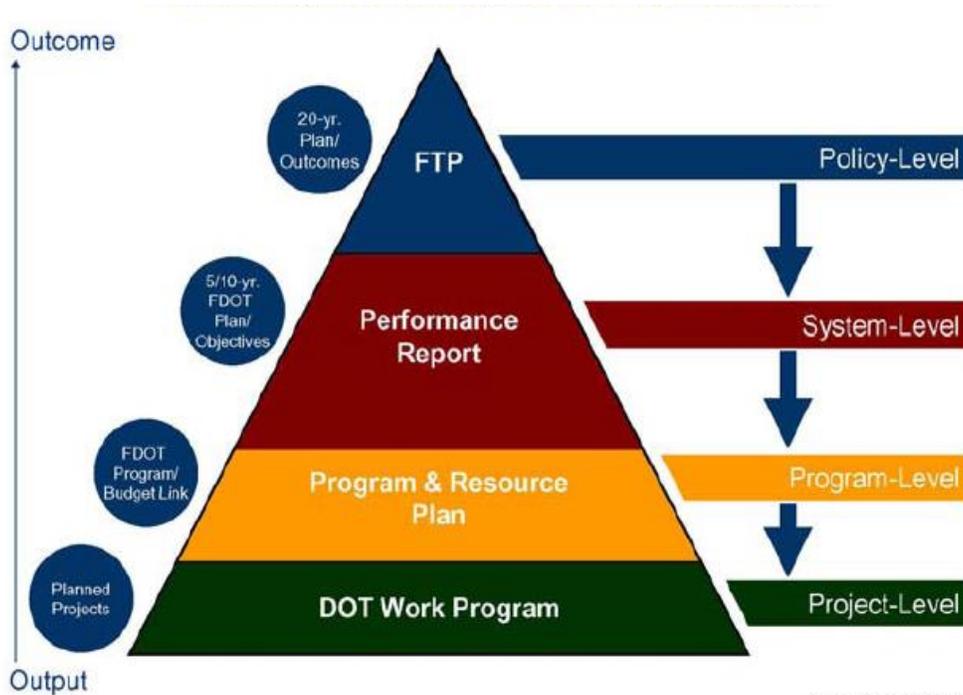
The North Carolina Department of Transportation (NCDOT) uses performance measures relating to pavement condition, traffic congestion and roadway safety to prioritize transportation needs and project programming. Projects are ranked according to their ability to address the Department’s goals identified in the long-range plan and included in the program of projects accordingly. Under State Executive Order in 2009, NCDOT experienced reform of their plan and project award process and NCDOT officials developed a goal-oriented data driven process. NCDOT calls their strategic decision-making framework “Policy to Projects” (Figure 6). NCDOT defines goals for the Department and key strategies to achieve the goals in the long-range plan. This foundation guides decision making and establishes a Department investment strategy [33].



**Figure 6: NCDOT "Policy to Projects" Framework [33]**

The NCDOT model is based on the Florida Department of Transportation’s (FDOT) process of strategic planning, which exemplifies an agency in the third generation of performance management. As shown in Figure 7, the Florida Transportation Plan (FTP)

and the Annual Performance Report are two components of FDOT’s strategic planning process. The FTP is the long-range transportation plan outlining the short-range objectives and long-range goals for transportation in the State. Performance is measured in the Annual Performance Report, evaluating how effectively the Work Program (project programming) addresses the State’s transportation needs established by the FTP.



**Figure 7: FDOT Performance Measures Framework [34]**

While FDOT long-range visioning is not definitively performance-based, reported outcomes are used to inform goal setting in the planning process as shown in the Department’s “continuous cycle of improvement” (Figure 8). FDOT also explicitly links project programming and budgeting to planning decisions, tying funding allocation to their goals and performance [34].



**Figure 8: Florida DOT "Continuous Cycle of Improvement" [34]**

## 4. Performance Measurement

*“The real value of performance measurement is in the development of an improved decision making and investment process, not the achievement of many arbitrary short-term targets.”*

- International Scan on Performance, FHWA/AASHTO, 2004

Performance measurement makes up the majority of a performance management system. By selecting an effective suite of performance measures, an agency translates its strategic goals into action items. By evaluating their defined performance measures on a regular basis, the agency tracks its progress and effectiveness in meeting its stated goals. When it is based on current and accurate data, the information provided by performance measurement allows the agency to adjust its future actions in order to improve performance.

### 4.1 Selecting Performance Measures

Based on the Transportation Planning and Management literature, it is possible to distill the following four principles for designing an effective suite of performance measures: meaningfulness, practical measurability, comprehensiveness, and conciseness.

1. **Meaningfulness:** Meaningful measures are “specific and well-defined (NTSA, 2011).” They directly relate to the policies and strategic goals that define an agency’s focus, and they are understandable to technical and non-technical audiences both within and outside of the agency [25]. This principle supports both *vertical and horizontal integration* [21] in an agency’s decision-making process:
  - Vertical integration refers to coherence between strategic planning and project-level decision making.
  - Horizontal integration refers to communication and coordination across functional units, allowing for multi-disciplinary decision making and tradeoffs.
2. **Practical Measurability:** Measurable performance measures are numerical, allowing them to be easily tracked and evaluated based on data. The underlying data may be qualitative or quantitative, but when transformed into a performance

measure, it must be quantified. For practical measures, the necessary data is readily and regularly available at reasonable cost [25, 13].

3. **Comprehensiveness and Balance:** An effective suite of performance measures will provide a balanced picture of the agency's effectiveness. There are multiple types of performance measures, which give different types of information: input, output, process, outcome and efficiency measures [9, 25, 14]:
- *Input measures* are the resources available to an agency. These include financial resources (e.g., money), human resources (e.g., the number of staff hours), equipment, materials (e.g., amount of asphalt used), information, etc.
  - *Output measures* are the products and services delivered by the agency or its contractors (e.g., number of lane-miles repaired, new projects completed).
  - *Process measures* capture the rate of progress of an agency on various fronts. Process measures are often used in maintenance and operations (e.g., lane miles resurfaced per month, customer service calls answered per week); but they can also be used in planning (e.g. number of participants included per public meeting). Process measures can also be expressed as ratios of actual outputs to planned outputs (e.g. percent of planned projects completed in a fiscal year).
  - *Outcome measures* are the effects (consequences) of agency activities, which are relevant to customers, other stakeholders, and the general public (e.g., changes in the smoothness of ride, travel delay, emissions, and customer satisfaction).
  - *Efficiency measures* are ratios between the outputs or outcomes produced and the inputs expended (e.g. dollars per lane mile repaired).

Although not very meaningful alone [37], input measures are important for accounting. Also, existing and projected estimates of the resources available to an agency can help define the feasible limits for planning and programming activities. Output measures related to expenditures are closely related to input measures and help to balance accounts and evaluate the effectiveness of planning and programming efforts. Output measures related to project delivery are more closely related to outcome measures that are more meaningful to stakeholders. Measuring performance in outputs gauges the success of individual activities that promote the achievement of outcomes. Similarly, measuring the performance of outcomes produces information regarding the progress made toward the achievement of larger goals and objectives such as mobility, safety and equity [38]. Outcome measures are generally considered most meaningful because they help the agency demonstrate accountability and commitment to strategic goals [26]; however, outcomes may be difficult to attribute to agency actions directly. This is because outcomes partially depend on factors that are outside of the agency's

control, such as human behavior and weather conditions. This “attribution issue” can be addressed by modeling the relationships between outputs and outcomes [25].

Measures may also be categorized as leading or lagging. Leading measures or indicators track performance before a problem arises. They are resource-related or task-related measures, and are predictive in nature. Lagging measures or indicators, on the other hand, track results. They show the results of a particular action or activity, and while they may be more accurate than leading indicators in determining outcomes, they are not predictive. Input and output measures are examples of leading measures. While important, they are insufficient on their own. They must be coupled with outcome measures, which are lagging measures.

4. **Conciseness:** A suite of too many measures, or very complex measures, can be difficult to calculate and to communicate, wasting time and money [25]. The most effective suite of measures will be concise, or “clinical” [39], meaning that it includes only those measures which are relevant to decision making.

#### 4.2 Example Frameworks for Principled Performance Measurement

There are multiple frameworks that an agency could adopt to provide guidance for designing a principled suite of performance measures. Three such frameworks are presented below.

##### *4.2.1 Goal-based Matrix (Louisiana DOTD)*

Table 2 shows an example of how the Louisiana Department of Transportation and Development (LDOTD) organizes its suite of performance measures in terms of strategic goals and objectives.

**Table 2: Example of organization of performance measures from Louisiana Department of Transportation and Development [40]**

GOAL	Performance Indicator Matrix Deliver cost-effective products, projects, and services in a timely manner.				
Objective	Input	Output	Outcome	Efficiency	Quality
Objective 2.1.4: Complete 100% of the required water resources infrastructure condition and serviceability assessments (flood protection systems, dam safety, and water wells) each fiscal year through June 30, 2013.	Number of levee districts having hurricane protection systems that require assessments.	Actual number of completed assessments for levee districts having hurricane protection systems.	Percentage of required levee district assessments completed.	Percentage of all water resource infrastructure conditions and serviceability assessments completed.	Number of levee districts with an overall hurricane inspection system rating of Good, Very Good, or Excellent.
	Number of new registered water wells in the state.	Number of new registered water wells that meet construction standards.	Percentage of new registered water wells that meet construction standards.		
	Actual number of dams scheduled for inspection per year.	Actual number of dams inspected per year.	Percentage of dam safety inspections on schedule.		

As shown in Table 2, LDOTD’s organization of performance measures demonstrates both vertical alignment and comprehensiveness: performance measures are linked directly to strategic goals and objectives, and each objective is comprehensively addressed through input, output, outcome, efficiency, and quality measures. “Quality” measures are essentially outcome measures with a focus on the service or experience provided to system users. This sort of framework can also contribute to horizontal integration if objectives are structured similarly in different functional divisions.

*4.2.2 Balanced Scorecard*

The Balanced Scorecard model, conceived in the field of Business Management and Accounting in 1992, has now been adopted by several transportation agencies, including Illinois DOT, Texas DOT, New York DOT, New Hampshire DOT and the City of Charlotte DOT (North Carolina) [21]. This model organizes an agency’s goals in terms of whether they are internal or external, process-oriented or results-oriented. Figure 9 below illustrates one application from Texas DOT in 1998.

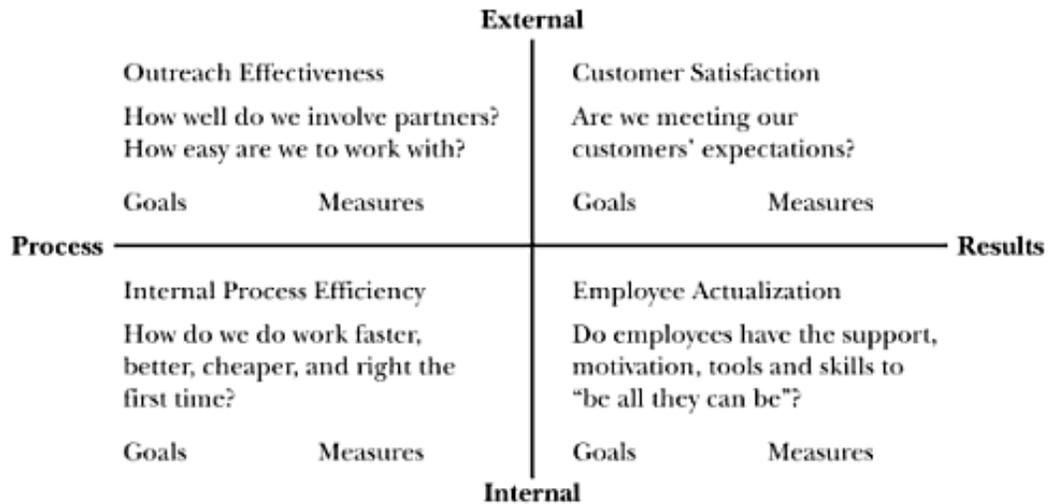


Figure 9: Example of the Balanced Scorecard Framework from Texas DOT [41]

As shown in Figure 9, once goals are categorized according to the balanced scorecard framework, measures must be defined in each goal area in order to achieve vertical integration. This framework can be thought of as a tool for developing a meaningful and concise set of measures. For comprehensiveness, the five categories of inputs, outputs, outcomes, efficiency and quality can still be considered within each of the balanced scorecard quadrants, with the understanding that certain measures are better suited to project-level decision making than network-level decision making, and vice versa.

4.2.3 Stakeholder-focused Performance Prism

The performance prism is a model for developing performance measures based on five stakeholder-focused concerns. It is envisioned as a triangular prism, as shown in Figure 10 below, with each facet representing one of "five distinct, but logically interlinked, perspectives on performance [42]."

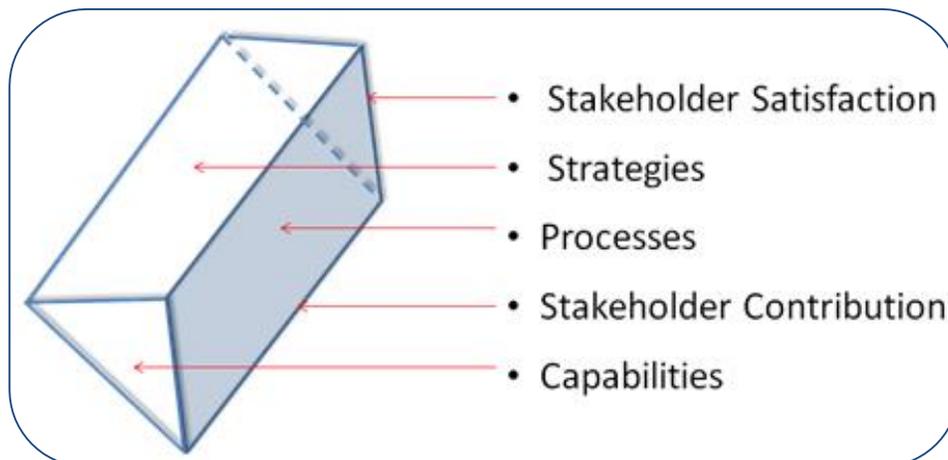


Figure 10: The Stakeholder-Focused Performance Prism Model [Adapted from 42]

Each of the facets of the performance prism is defined by a question that can guide the selection of performance measures from a stakeholder-oriented perspective:

1. **Stakeholder Satisfaction** – Who are the key stakeholders and what do they want and need?
2. **Strategies** – What strategies do we have to put in place to satisfy the wants and needs of these key stakeholders?
3. **Processes** – What critical processes do we require if we are to execute these strategies?
4. **Capabilities** – What capabilities do we need to operate and enhance these processes?
5. **Stakeholder Contribution** – What contributions do we require from our stakeholders if we are to maintain and develop these capabilities?

As far as could be found, there are no transportation agencies currently using this prism method. However, it can be seen as an important tool for developing meaningful measures, and it has special relevance to developing measures of transportation quality because of the focus on stakeholder needs, although the efforts involved in identifying stakeholders and capturing their needs cannot be underestimated.

#### 4.3 Example Measures in Important Goal Areas

Effective performance measures will be directly linked to strategic goals, in order to support agency decision making that will help achieve those goals. Several goal areas are described below, with examples of the measures used in them. The example measures described and performance documents for each state are referenced in the Midwest Transportation Knowledge Network’s database of performance measures used at State DOTs [43].

Volume I Appendix A: Complete Literature Review

### INNOVATIVE SAFETY MEASURES

#### Tracking Efficiency

- **Louisiana** measures crash rates before and after each individual safety improvement and tracks percent reduction in the annual fatality rate. Measurements are made at locations with abnormally high crash rates as well as across the whole network.
- **Montana** tracks the number of correctible crash sites funded for improvement.
- **Illinois** tracks the number of safety improvements accomplished per year

#### Creating Actionable Measures

- **South Carolina** tracks the top probable causes and top locations for highway crashes and fatalities.
- **Iowa** and **North Dakota** report the annual percentage of crash reports that are submitted electronically, connecting safety with data processes.

#### Fostering Stakeholder Buy-in

- **Maryland** tracks customer perceptions of safety on the MTA transit system while **Oregon** tracks the percent of the public that feels safe on the transportation system as a whole.
- **North Carolina** tracks an “employee safety index,” combining employee injury rates, equipment accident rates and workers compensation claims.

#### Making Comparisons

- **California** benchmarks its fatality rates against the U.S. average.
- **Washington** compares the congestion and non-motorized mode share of its cities by population size.

#### 4.3.1 Safety and Security

Safety and security is the #1 goal area, considered by an estimated 67% of state DOTs [21]. A very outcome-oriented area, safety is most commonly tracked by the **number of annual incidents** AND/OR **incident rates** per 100 Million VMT or 100,000 people, including

- Crashes
- Injuries
- Serious or immobilizing injuries
- Fatalities

Several states separate incidents by mode, cause and/or circumstance. In particular, separate measures are tracked for incidents associated with

- Pedestrians
- Bicycles
- Motorcycles
- Alcohol use
- Seatbelt use or nonuse
- Construction zones

Other safety-related measures include

- Seat belt compliance rates
- Employee safety measures

#### 4.3.2 Asset Management and Preservation

Asset management and preservation is the #2 goal area, considered by an estimated 56% of state DOTs. It can include input measures related to a DOT's asset inventory, output measures related to project delivery, and outcome related to the condition (or quality) of assets as experienced by the system users.

- **Inventory** measures list the number of assets belonging to the agency by category.

### STATE OF THE ART ASSET MANAGEMENT MEASURES

#### Measuring Asset Condition

- **Ohio** rates condition for multiple bridge elements, including the deck floor, deck surface and paint condition.
- **Vermont** constructs a network-level measure for pavement condition, which is weighted by traffic volumes.

#### Tracking Project Delivery

- **Florida** tracks the number of assets inspected by type each year.
- **Minnesota** tracks the dollars spent on inspections, repair and maintenance each year.
- **Washington** tracks the percentage of scheduled maintenance tasks completed per annum and uses this to project an estimated backlog and investment need for the following year.
- **South Carolina** tracks its top seven maintenance activities undertaken in each quarter, by spending amount.
- **Delaware** tracks the percent reduction in their drainage work order backlog.

#### Responding to Stakeholders

- **Missouri** tracks the percent of ancillary assets that meet customer expectations.

- **Project delivery** measures related to asset management include the number or percent of scheduled inspections or maintenance tasks completed.
- **Condition ratings** are often on a qualitative scale, and aggregated by asset type.

The most common assets tracked by DOTs are pavements and bridges.

**Pavements** are tracked in lane miles or centerline miles, and they are separated based on pavement type (concrete or asphalt). Pavement condition is measured as

- Percent acceptable or percent distressed
- Percent good, fair, and poor IRI
- Pavement condition index (PCI)
- Pavement condition rating (PCR)

**Bridges** may be separated by type (major or minor, or by another functional classification). Bridge condition measures include

- Percent structurally deficient OR sufficient
- Percent having a condition rating of either excellent or good OR poor
- Bridge health index

Some DOTs have started tracking inventory and condition for other, “ancillary assets” and properties, including signs, pavement markings, culverts, retaining walls, carpool lots, real estate, buildings, equipment and machinery.

#### *4.3.3 Transportation Systems Efficiency*

As the #3 goal area, transportation systems efficiency includes measures related to mobility, reliability, and accessibility outcomes, and it is considered by an estimated 53% of transportation agencies.

**Mobility** refers to the ability for people (and goods) to get places. Mobility measures include typical or average travel volumes and travel speeds, aggregated by a particular time period such as months or years. They could also include aggregate, network-level measures related to delay and congestion. For example:

For Passengers

... *On the Road*

- Vehicle Miles Traveled (VMT)
- Percentage of the roadway network (lane miles or centerline miles) with average traffic volumes at congested levels (above capacity), OR percent un-congested.
- Average travel time on selected routes

*...On Transit*

- Transit boardings and ridership, segregated by mode or route

*...Long-Distance*

- Intercity rail or bus boardings,
- Airline enplanements

*...Going to Work*

- Average commute time by region

For Freight

- Annual cargo passing through seaports and airports
- Freight tonnage traveling along rail lines and truck corridors

**Reliability** refers to the level of confidence that a traveler can have in a particular link or network. Reliability measures have to do with congestion, delay, and travel time variability, including

- Daily vehicle hours of delay, aggregated by state or region
- Average incident duration or clearance time
- Percent of major incidents cleared in less than a target value (such as 90 minutes), tracked separately for types of accidents
- Percent of transit service (by type) that runs on time

**Accessibility**, the newest area of transport efficiency measures, refers to

- Availability of travel choices (i.e. modes) within a reasonable distance of people's homes
  - Peak hour capacity by mode
  - Percentage of population with access to particular modes
- The number and types of destinations that can be reached via the transportation network

**INNOVATIVE ORGANIZATIONAL DEVELOPMENT MEASURES**

Developing Human Resources

- **North Carolina** surveys employees and tracks their levels of emotional and rational commitment, discretionary effort, and intent to stay. NCDOT also measures “the percent of active leadership positions that met or exceeded performance expectations.”
- **California** tracks the percent of first-choice candidates that accept the Department’s entry-level job offers.
- **Missouri** tracks the promotion rates and separation rates of minority and female employees.
- **Delaware** tracks the number of “town hall meetings” to receive employee input AND the percent of employees cross trained in multiple disciplines.

Tracking Fiscal Efficiency

- **Colorado** tracks the relationship between revenue and full time equivalents (FTEs).
- **Colorado** also tracks changes in the relative value of its motor fuel tax due to inflation.
- **Texas** tracks the percentage of design tasks and construction contracts that are completed on budget, as well as whether or not the DOT is meeting its overall budget.

Acknowledging Achievement

- **Missouri** tracks the number of external awards received, innovative technologies used, and new products evaluated by the DOT.

#### 4.3.4 – 1 Organizational Development

Tied for the 4<sup>th</sup> most common goal area, and considered by an estimated 28% of DOTs, Organizational Development relates to human resources-related measures, fiscal concerns and program delivery. Each of these categories can include input, output, outcome, and efficiency measures.

**Human resources** and **employee related** measures consider such issues as:

- Total time to hire or process an application
- Employee work hours (full time equivalents)
- Employee performance ratings
- Percent compliance or percent completion of employee trainings
- Turnover rates
- Job satisfaction rates
- Percent of employees in certain demographic categories

**Fiscal measures** track such things as:

- Revenues, in dollars, segregated by funding source (e.g. motor fuel tax; tolls)
- Expenditures, in dollars, by program or project type
- Costs of certain project types, normalized by mile or some other value
- The percent of total funds spent on certain activities, including
  - Administration
  - Engineering
  - Debt service
- Differences between forecasted and actual dollar amounts, including
  - Revenue forecasts
  - Engineer-estimated costs
- Ratios of revenues and operating costs for certain activities
- Cost savings from certain activities

**Program delivery** measures are output or efficiency-oriented. They track completion or delivery of a variety of tasks, including:

- Contracts awarded
- Projects completed
- Documentation completed (environmental; legal; audits; etc.)
- Permits approved

Common aggregations of program delivery measures include the number or percent of scheduled tasks completed

- On-time, or in a timely way (e.g. within 4 days)
- On-budget

- Per fiscal year

#### 4.3.4 – 2 Relationship with External Stakeholders

The other goal area tied for 4<sup>th</sup> place is actually **customer satisfaction**, a measure of the extent to which an agency is meeting its customers' expectations. Other measures which track the agency's relationships with external stakeholders include:

- **Customer service measures** such as
  - Percent of correspondence (emails, calls) responded to within a designated time period
  - Average wait time at service destinations such as the department of motor vehicles (DMV)
  - Number of complaints per 100,000 users or customers of a particular transportation service
- **Public relations and outreach measures**, such as
  - Reports published,
  - Public meetings held
  - Participants at public meetings
  - Website hits
- **Partnership measures** such as
  - The number of projects (in a certain category) implemented in partnership with other agencies (such as municipalities, private funding partners, etc.)
  - Funds generated or costs saved through partnerships
  - Partner satisfaction ratings
- **Equity measures** such as the percent of contracts awarded to disadvantaged business enterprises.

#### 4.3.5 Sustainability-related Outcomes

Several agencies have begun to measure transportation outcomes related to sustainability and sustainable development. The principles of sustainability can be summarized in four points, according to a new NCHRP Guidebook [44]

- Preserving and restoring environmental and ecological systems,
  - Fostering community health and vitality,
- Volume I Appendix A: Complete Literature Review

#### **INNOVATIVE MEASURES FOR RELATIONSHIP BUILDING**

- **Delaware** tracks a number of outreach activities, including training sessions with vehicle dealers and hits on a teen-focused website.
- **Oregon** tracks the percentage of local participants who rank the public involvement activities of ODOT's Economic Revitalization Team as good or excellent.
- **South Carolina** tracks the percent of land owners who are satisfied with DOT's right-of-way acquisition process, paired with the percent of lands acquired by eminent domain.

- Promoting economic development and prosperity, and
- Ensuring equity between and among population groups and over generations.

Another guidebook, from the EPA [45], points out that existing measures related to multimodal transport efficiency can address multiple sustainability objectives. These include measures of

- Safety,
- Mobility, and
- Accessibility
- Transit users
- Bicyclists, and
- Pedestrians

**MEASURING SUSTAINABILITY**

Environmental Stewardship

- **Connecticut, Missouri, and Vermont** measure the amount of recycled materials (asphalt, demolition debris, wood, and steel) used in projects.
- **California, Maryland, and Missouri** track fuel consumption in their states.
- **Maryland, Missouri and Texas** calculate greenhouse gas emissions from transportation systems and DOT activities.
- **Maryland** also segregates emissions production by region and calculates emissions savings from specific projects (e.g. park and ride facilities).
- **Iowa, Maryland, and Nebraska** track the preservation, creation, restoration and improvement of wetlands and other habitats.
- **Oregon and Washington** track the number of culverts which allow sufficient fish passage.

Economic Impacts

- **Oregon** and **Missouri** track job creation for DOT activities, and **Virginia** estimates the economic activity and jobs generated by its aviation and port-related business.
- **Utah** estimates the annual user costs saved, and **Nevada** estimates the economic impacts of lives saved through transportation improvements.

Community & Social Development

- **The Federal Highway Administration's** Community Impact Assessment website [46] lists possible community impacts of transportation including population change, barriers to interaction, sound and vibration impacts, and aesthetic impacts.
- **The U.S. Environmental Protection Agency** [37] suggests tracking the average share of household income spent on transportation and housing, the distribution of transportation benefits by income group, and the mix of land uses accessible by transit.

To achieve sustainability outcomes, DOTs and other transportation agencies will need to collaborate across jurisdictional boundaries and integrate sustainability principles into every level of performance management [43]. Some of the agencies most advanced in using sustainability-oriented performance measures in transportation decision making are metropolitan planning organizations (MPOs) and other regional and local organizations [43].

4.4 Collecting and Managing Performance Data

*4.4.1 Data Needs for Different Time Contexts*

It is necessary to consider the point in the project or program at which performance is being measured, as there are different types of measures that are used at different times. Decision-making measures are used to aid in making choices about the type of project to implement and are used at the beginning of the decision-making process. Post-occupancy measures are used after the project is complete to determine how well it is

achieving its goals [47]. The major distinction between the two types of measures is regarding how the data is obtained. With decision-making measures some sort of prediction must be made using modeling or statistical methods. However, with post-occupancy measures, data is recorded from actual events. Often the information contained in the measure is the same when comparing decision-making measures with post-occupancy measures; only the collection process is different. For example, an agency may determine the projected daily volume of a proposed roadway, but then measure the actual daily volume once the roadway is constructed.

#### *4.4.2 Data Collection*

Once performance measures have been created, data must be collected for measurement. Some questions to ask that may help guide agencies to the correct data, sources, and collection and measurement methods are below [48]:

- What needs to be measured?
- Where should measurements be taken?
- Is it necessary to measure the presence or absence of something, or must the degree or magnitude be measured?
- How accurate and precise must the measurements be?
- Must the measurement occur at a particular point in time?
- How often should measurements be taken?

#### *4.4.3 Data Analysis and Management*

The effective use of data with analytical tools is critical to the success of a performance management program. Accurate and comprehensive data is a necessary component of the analysis. The following points illustrate the importance of effective data collection, analysis, and management [25]:

- Comprehensive inventory of assets helps to organize performance measures for future reference.
- Periodic inspections give adequate information for comparisons across different time periods.
- Analytic predictions of condition are critical for trade-off analysis and alternatives evaluation.
- Defined condition or performance thresholds give indication of when treatments should be given.
- Models predicting the cost and effectiveness (life added) of treatments help predict the remaining life of assets.
- Impact models determine the effectiveness of analytic tools.

Data integration is the process of combining or linking two or more datasets from different sources to facilitate data sharing, promote effective data gathering and analysis, and support the overall information management activities in an organization. Data integration in asset management systems is important due to the large quantities of data used in

these systems. Data integration and the integration of their asset management functions allow for effective sharing across and within agencies, as well as more holistic decision making under budgetary and other resource constraints [49]. In a recent survey on ancillary Transportation Asset Management in selected states, multiple states reported that they have some level of integration at the database level or both database and data analysis levels. A number of states indicated a transition toward integration [50].

#### 4.4.4 Quantification of Qualitative Data

Some data is not easily measured quantitatively. There are multiple methods for making this type of qualitative data comparable, including monetization and the scoring system method.

**Monetization** attempts to place a monetary value on certain characteristics of asset performance, such as when estimating the remaining useful life of an asset. Monetization can also be used with outcomes as in determining a value of time when measuring mobility or a value of life using missed work or medical costs when measuring safety. When taking this approach, it is recommended that both direct and indirect effects are monetized for a more comprehensive result. Distinguishing between direct and indirect effects can be difficult because external factors often come into play. This issue is commonly referred to as an attribution issue. One way to distinguish between external and agency effects is to use traffic simulations and trends in relevant data to predict the impact of projects or programs on system performance. The impacts can then be monetized using one of the following methods: calculating damage costs, control or prevention costs, hedonic methods (i.e. utility-related methods), contingent valuation, compensation rates, or shadow prices. Putting all parameters into the same units (dollars) makes them easier to compare. However, monetization of impacts can sometimes cause problems because the attributed values are subject to bias.

**The scoring system method** formulates normalized scores for performance indicators based on a clear hierarchy of values within the organization [46]. For example, in order to develop its Safety Performance Index, the Eastman Kodak company first assigns each performance indicator a weight representing its overall importance to the organization. Then, “performance levels” are designated, in which level 7 represents a baseline value, level 3 represents a goal, and level 1 represents a “stretch goal... [which] should be attainable, but only if [the organization] performs superbly.” Other performance levels, both below and above the baseline, are defined. Performance is measured and evaluated with respect to the defined levels. The score for each indicator is its performance level multiplied by its weight. These scores are summed to generate the overall performance index, which can be compared to a baseline index value and goal values. The performance matrix used by Eastman Kodak for its Safety index is shown in Table 3.

Table 3: Example of a Completed Eastman Kodak Performance Matrix [48]

Performance Indicator (PI)	Performance Level										Calculations			
	1	2	3	4	5	6	7	8	9	10	Value	Level	Wt.	Score
Unplanned Safety Function Actuations	15	20	30	35	40	45	50	60	70	80	38	5	20	100
Violations of Operating Procedures	8	15	25	30	35	40	45	50	55	60	50	8	30	240
Unplanned Shutdowns	10	15	20	23	25	27	30	34	38	42	23	4	30	120
Number of Unusual Occurrences	20	25	35	45	50	55	60	65	70	75	53	6	20	120

#### 4.5 Setting Performance Targets

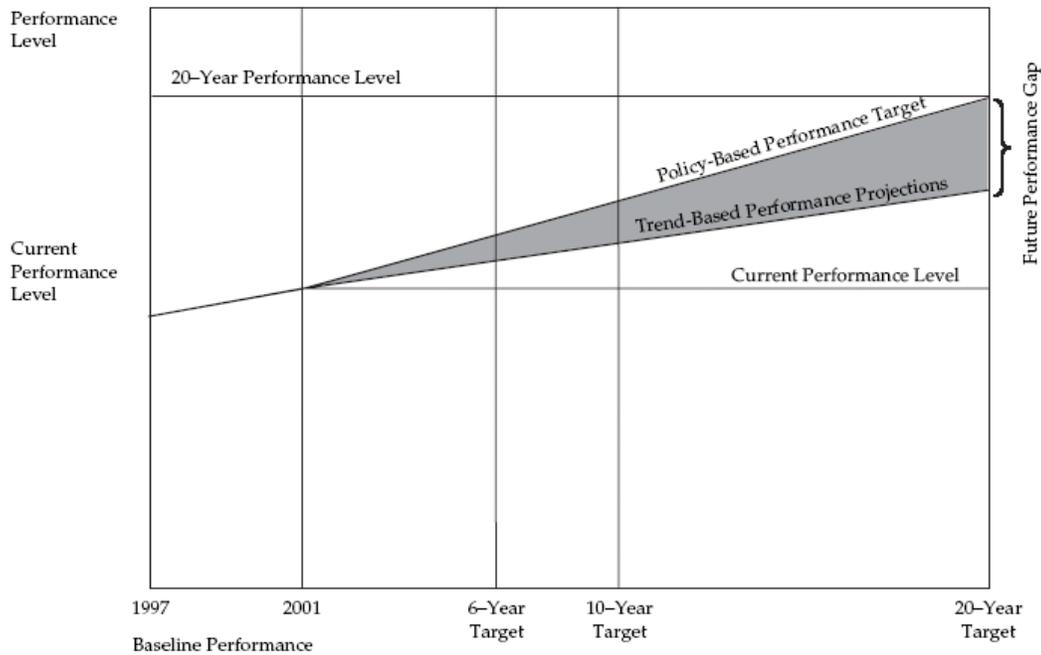
Performance targets define numerical performance levels that an agency wants to achieve within a particular timeframe. According to the results of a 2009-2010 Performance Survey sponsored by GDOT, about 79% of U.S. State DOTs set performance targets [51]. For example, Louisiana DOTD sets the project delivery target of “Comple[ing] 100% of the required... assessments... each fiscal year... through June 30<sup>th</sup>, 2013.” In general, the following attributes of effective targets can be distilled from the literature [25].

##### 4.5.1 Characteristics of Effective Performance Targets

1. **Timebound:** Targets can be short term, mid-range or long term. The appropriate time scale for a target will depend on the decision-making context in which it is used. Often short-term targets can be used along the way toward achieving a long-term goal.
2. **Achievable:** A useful target will be achievable, both in terms of available funding and technical ability.
  - **Financial Feasibility:** In general, realistic funding projections should be used when setting targets. Short term targets are especially dependent on available funding, since longer term targets can be adjusted based on short term achievement.
  - **Technical Feasibility:** Targets should be based on realistic forecasts of conditions and performance. For example, targets for asset management should take into account degradation rates, and targets for operations should take into account population and employment growth rates.

However, technical feasibility should not be used as an excuse for setting targets that are not ambitious; a variety of scenarios can be considered to determine the highest possible performance which is still technically feasible.

3. **Strategic:** Long term targets can be primarily based on the goals and ideals of the agency. For example, if there is a performance goal to “maintain” the transportation system, long-term target setting must answer the question “what defines a well-maintained system?” Short-term and mid-range targets can be developed in accordance with financial and technical feasibility in order to make steady progress toward the long-term goal.
4. **Well-Communicated:** In order to be an effective decision making tool, performance targets must be effectively communicated alongside actual performance. This way, decision makers can make adjustments in policy and programming in order to make better progress toward long-term goals, or to save money when progress is well under way. Figure 11 and Figure 12 below show examples of how two State DOTs report their performance information, including targets.



**Figure 11: Minnesota DOT's Performance Target Levels [25]**

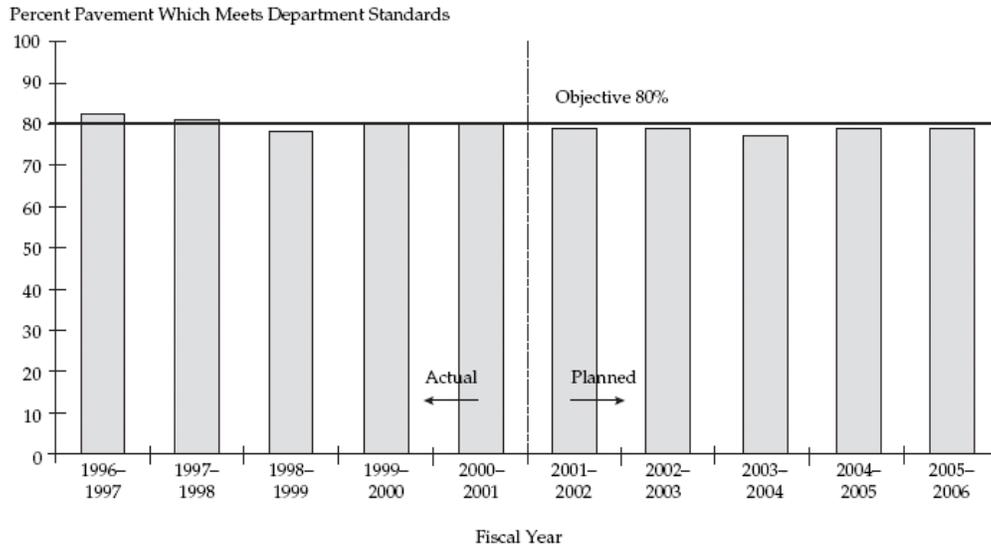


Figure 12: Florida DOT's "Measurable Objective: Pavement Condition" [25]

## **5. Funds Allocation and Programming**

The country’s transportation agencies have been coping with limited funding for years prior to the economic recession; however, the negative financial climate at the end of the last decade has increased fiscal constraint in all government agencies, including transportation agencies. As a result, there has been a shift at the Federal level and among many states toward performance-based methods of prioritizing and programming projects and allocating limited funds.

### 5.1 Performance-based Policy for Decision Making and Funds Allocation

Since 1991, Federal legislation, such as surface transportation funding authorizations and two “Government Performance and Results Acts”, has required transportation agencies to implement some level of performance measurement. In 2012, the national Congress reauthorized the surface transportation law requiring a performance-based approach in transportation decision making [52]. The implementation of performance measures and performance management in practice, however, is still a work in progress. In a December 2010 report, the U.S. Government Accountability Office (GAO) found that implementation of transportation projects depends more on “political and public support” than objective, performance-based analyses, saying that “only a select few states have made significant attempts to integrate performance measurement into their statewide planning process to inform investment decisions” [11].

A study by PEW Center did a countrywide survey of state DOTs to determine the use of goals, performance measures and data to influence choices in funding allocation in six policy areas related to the states’ economic well-being and citizen’s quality of life: safety, jobs and commerce, mobility, access, environmental stewardship and infrastructure preservation. The PEW study found the following [20]:

- 13 states had effectively integrated performance measures into their decision-making processes for these policy areas.
- 19 states had no comprehensive means to account for returns on transportation system investments.
- 39 states have passed legislation tying budget requests to performance data but actions towards using data for programming and funding allocations have been limited.

Policy options to enforce the connection between strategic goals and policy objectives and investment decisions can be found in

Table 4 [19, 25]. Practical means to achieve the link between performance data and investment decisions are also shown in this table.

**Table 4: Options for Linking Performance to Funding Allocation [19, 25]**

<b>Policy Objectives and Funding Allocation</b>
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Apply Performance Measures at Project, Program, and Policy Levels
-Use some of the same performance measures for multiple purposes: to set policy, allocate resources and measure and report results
Institutionalize the Connection Between Policy and Decision Making
-In each funding cycle, use performance information from previous cycles to influence the policies, plans, projects, programs, and funding allocations to be implemented in new cycle
<b>Performance Data and Funding Allocation</b>
Improve Quality of Information
-Improve usefulness of indicators -Ensure a strong link between measures and concrete goals -Develop communities of practice for benchmarking
Enact or Improve Performance Measure Legislation
-Lessen the gap between legislation and practice -Consider new Federal laws as models for states
Develop a Data-Driven Allocation Process
-Develop comprehensive data management systems to inform all budget decisions -Provide transparent information to internal and external stakeholders to account for political nature of funding decisions
Incorporate Economic Analysis in Decision Making
-Conduct cost-benefit analysis, cost-effectiveness analysis and economic impact analysis to determine the potential economic impacts of alternative investment options
Connect Goals, Performance Measures and Plans
-Use performance targets in long-range planning -Understand the importance of each performance measure and its relevance to agency goals -Determine how funding allocations affect performance
Track Citizen Responses to Decisions
Improve Internal and External Coordination
-Communicate decisions clearly
-Consider and incorporate stakeholder feedback when making new budget decisions

5.2 Funding Allocation in the Performance Management Framework

The allocation of resources is directed by the preceding steps in the Performance Management framework: setting goals, objectives, measures and targets [21]. Targets are set for each performance measure in order to evaluate the effectiveness of projects against the goals and objectives that have been identified in strategic planning. Targets set benchmarks against which agencies can evaluate the effectiveness of their investment decisions, and choose how to allocate funds based on projected outcomes. Therefore, funding allocation should be informed by performance data and also the goals established in strategic planning. For example, based on an investment plan developed through its strategic planning process, the North Carolina DOT practices “strategic prioritization” to create a “10-year Program and Resource Plan.” In this plan,

transportation projects are categorized by goal and then ranked based on objective performance data. This produces a prioritized, yet unconstrained list of transportation needs. NCDOT then integrates the prioritized list with its 10-year, cash-constrained budget to develop the “Program and Resource Plan.” The “5-Year Work Program” and the project list of the State Transportation Improvement Program (STIP) are derived from the “Program and Resource Plan.”

NCDOT based their process on the Florida Department of Transportation’s approach. FDOT explicitly links project programming and budgeting to planning decisions. This clearly connects funding allocation to goals and performance [34]. This is primarily done through the “Program and Resource Plan.” The FDOT “Program and Resource Plan” establishes financial and production targets for the state’s transportation program. It links the “5-Year Work Program” of all state transportation projects to the department’s annual budget.

## 6. External Reporting and Communication

Performance reporting is a necessary component of any performance management program. Reporting that is communicated to external stakeholders improves accountability of the agency and builds credibility and trust between the agency and public or government officials. Accountability to stakeholders is an important part of performance management. Reporting plays a significant role in accountability because making performance results available to anyone who wishes to view them may provide extra incentives to improve the way an office or agency functions and increase the accuracy with which data is collected. Also, the U.S. Government Accountability Office (GAO) has found that implementation of transportation projects depends more on “political and public support” than objective, performance-based analyses per se [11]. Effective communication of performance to political decision makers and the public is therefore critical to making a successful case for funding transportation needs and opportunities.

### 6.1 Principles of Data Presentation for Effective Communication

To effectively communicate with the public, special attention must be given to certain aspects of the presentation to avoid confusion or misrepresentation and to ensure that the public does not draw any unrealistic conclusions or expectations from the performance data [3]. Three principles of effective data presentation include:

1. **Accessibility:** Performance reports should be easy to understand and must make sense to a non-technical audience. Reports should be readily available to the general public via the web and other relevant media.

2. **Attribution:** When direct causal relationships are difficult to construct between certain outcomes and agency actions, relationships should be demonstrated through before-and-after studies or through the use of traffic simulations and trends in relevant data [25].
3. **Transparency:** All assumptions and direct or indirect relationships should be made clear to the public when presenting performance data. For example:
  - As a supplement to before-and-after studies of safety projects, the Washington State DOT's Gray Notebook [53] includes discussion about the difficulty in showing causal relationships of transportation safety projects.
  - Virginia DOT posts performance measurement data on the web, even if it is incomplete or possibly inaccurate. This policy decentralizes the responsibility for quality assurance, and it has led to dramatically increased data accuracy [10].

## 6.2 Reporting Styles

Many DOTs report performance via the agency website, which is updated on a quarterly or annual basis. Some agencies release a full performance report every year. The agencies surveyed in this study cover a wide variety of reporting styles and depth.

### 6.2.1 Reporting Media

- **Performance websites** include easy-to-navigate user interfaces, which allow the public to quickly access important categories of performance information,

#### WASHINGTON STATE DOT GRAY NOTEBOOK (GNB)

- All of the department's policy goals are described in the GNB, along with related objectives, progress, measurements for previous years, and whether or not goals have been met, using graphical displays.
- All performance measures are linked to strategic statewide policy goals. Some are updated quarterly while others are updated annually. The GNB gives significant detail for measures deemed important by WsDOT. For example:
  - The GNB's **mobility** section includes a quarterly incident response program update, which explains the importance of incidence response for reducing delay. The section also provides estimates of the economic benefits of the incident response program, and feedback from travelers who experience traffic incidents. These responses are collected by an incident response team, which distributes pre-addressed business cards onsite. Customers can also provide comments via email or online survey.
  - The **safety** section includes an analysis of injury and fatality-reducing highway projects
- Many of the performance measures are aggregated by region to determine if there are any geographical discrepancies or equity issues.
- The GNB includes special sections to call out designated sections for important programming areas that may only be alluded to elsewhere; for example, the 2010 GNB includes a special report on Federal Recovery Act-funded projects tracking the progress of these projects.

often organized according to the agency's strategic goals or functional divisions. For example, MnDOT's performance is reporting on the state's "Accountability Minnesota" website [54]. Other examples include "Dashboard" websites provided by the Oregon and Georgia DOTs [55, 56].

- **Real-time traffic websites** display data such as traffic speeds, road closures, estimated delay time, and other alerts on an interactive map in order to help travelers to better plan their trips, thereby improving the reliability of the transportation system. Examples include Oregon's TripCheck [57], Utah's CommuterLink [58], California's CalTrans Quickmap [59], and GDOT's NaviGator [60].
- **Performance reports** offer more extensive explanations of performance measures, targets, and processes. For example, Minnesota's Annual Transportation Performance Report summarizes MnDOT's strengths, gains, weaknesses and challenges for the year and offers explanations for the changes in performance over time [61]. MoDOT's "Missouri Tracker" is published quarterly and posted online, in-full and in sections for easy access [62].

### 6.2.2 Graphical Components

- **Dashboards** typically use traffic light colors to graphically portray whether or not an agency is meeting its performance targets. Examples come from the "ODOT Performance Dashboard" (Figure 13), "TxDOT Tracker" websites (Figure 14), GDOT's Performance Management Dashboard (Figure 15) and CalTrans' Quarterly Performance Report (16). Dashboards make several types of information (targets, ranges of acceptable performance, actual performance levels, and achievement gaps) easily accessible to the public.
- **Time series charts** display trends of agency performance over time, often combined with desired trend directions and target levels. Examples come from the "ODOT Performance Dashboard" (Figure 13) and CalTrans' quarterly performance report (Figure ).

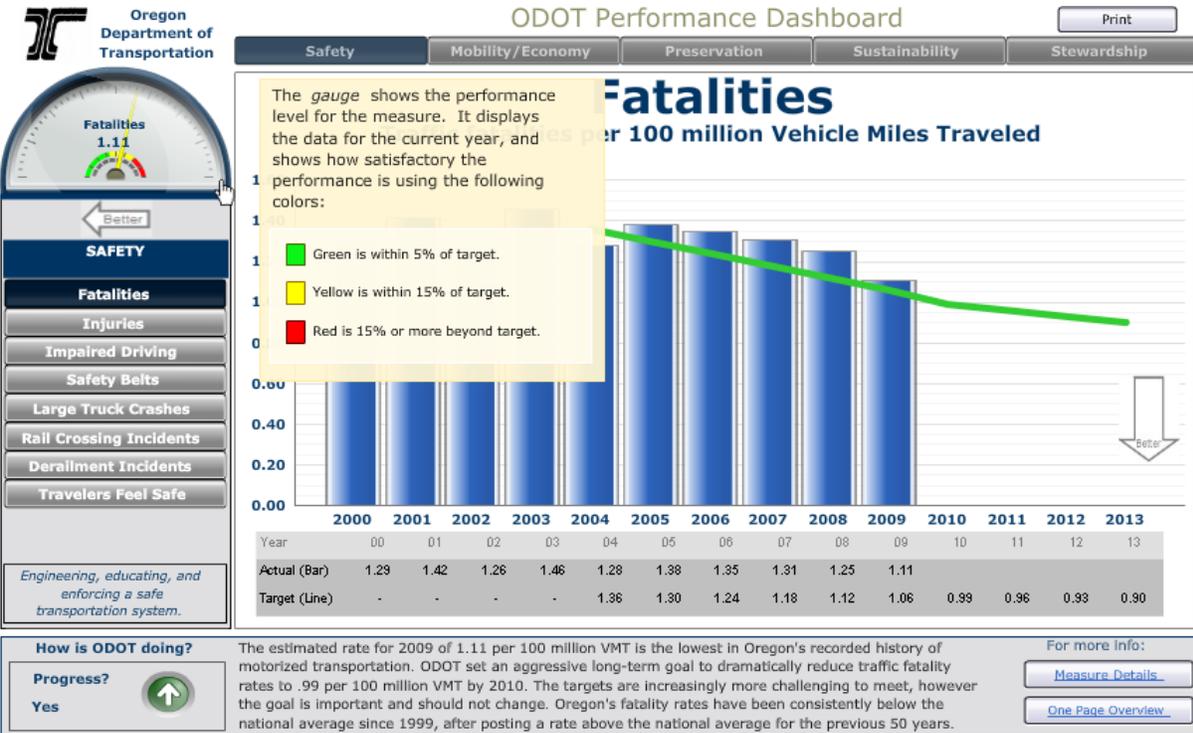


Figure 13: Screenshot of the ODOT Performance Dashboard website.

In Figure 14, A speedometer-style graphic in the upper left corner shows progress toward the fatalities target in three categories, using traffic light colors. A legend appears as a pop-up window when the cursor scrolls over the speedometer graphic. Also, the time series chart displays the actual annual variation in traffic fatalities (bars) since 2000, along with a trend line and arrow representing the desired target and trend direction [55].

As always, TxDOT welcomes [any suggestions](#) to improve this area.

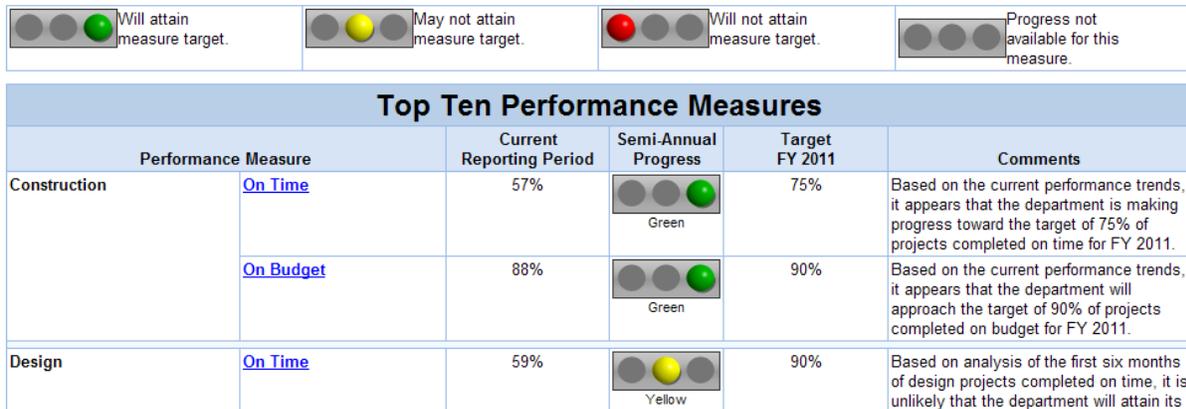


Figure 14: Screenshot of TxDOT Tracker Website. Semi-annual progress for TxDOT's "Top Ten" performance measures is portrayed using traffic light colors in three categories [63].

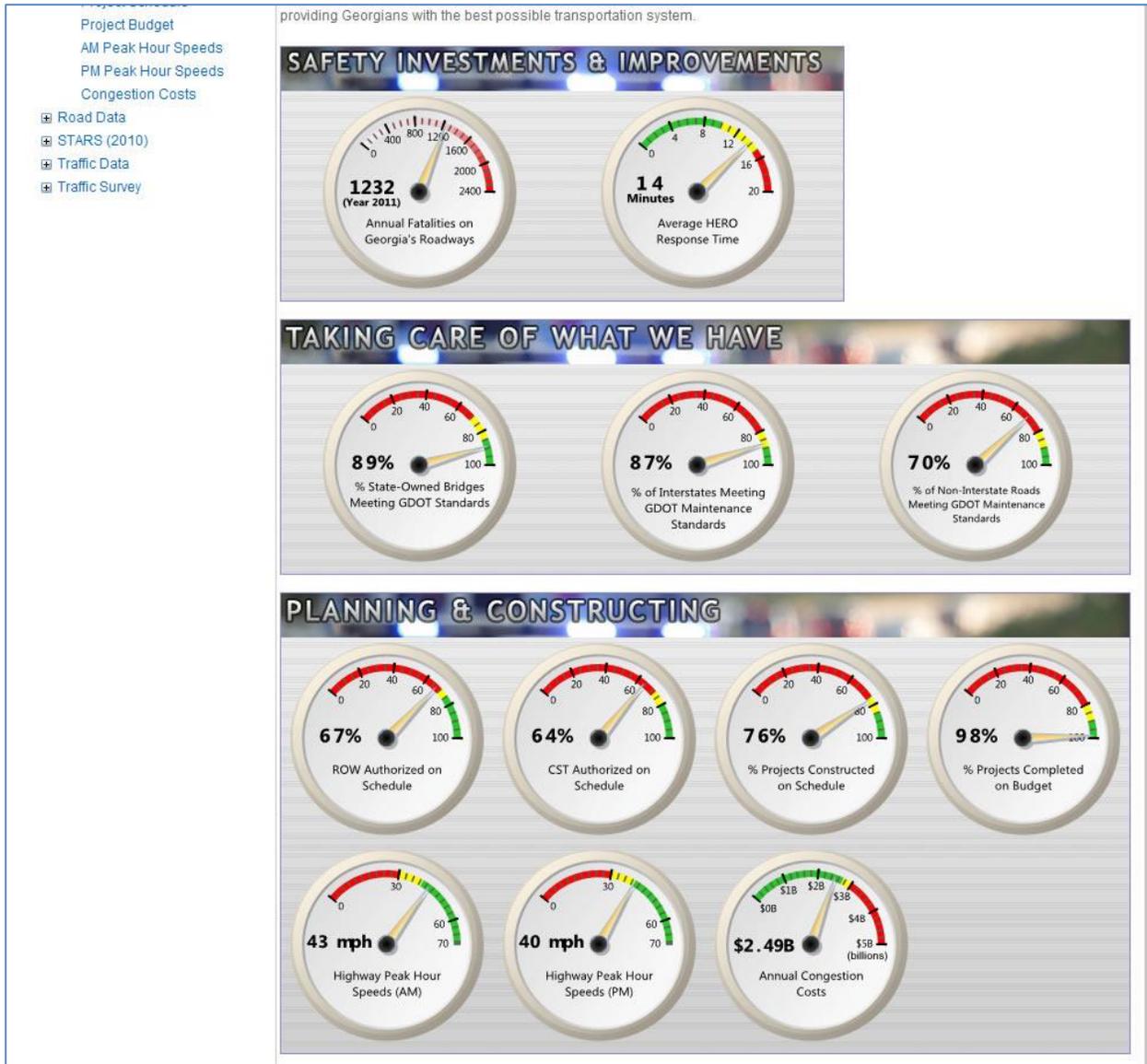


Figure 15: GDOT Performance Management Dashboard [56]

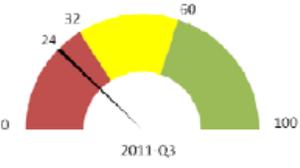
Mobility Goal – Maximize transportation system performance and accessibility.				
Performance Measure	Baseline	Target	Current Data	Comments
PM 2.2b Percent of major incidents cleared in less than 90 minutes. 	32	>60	24	There were 157 Major incidents reported in the Major Incident Database in the July-Sept quarter (Q1 of Fiscal Year 11/12) of which 38 were cleared in 90 minutes or less. The average clearance time was 3 hours 49 minutes.  The baseline was established from the January-March quarter in 2007.

Figure 16: Screenshot from Caltrans' "Key Dashboard Performance Indicators," the first section of its Quarterly Performance Report.

In Figure 16, A speedometer-style graphic is used with traffic light colors indicating measurements below baseline, between baseline and target, and above target levels. Only 16 measures, the most important and most frequently updated measures, are presented as key dashboard indicators [64].

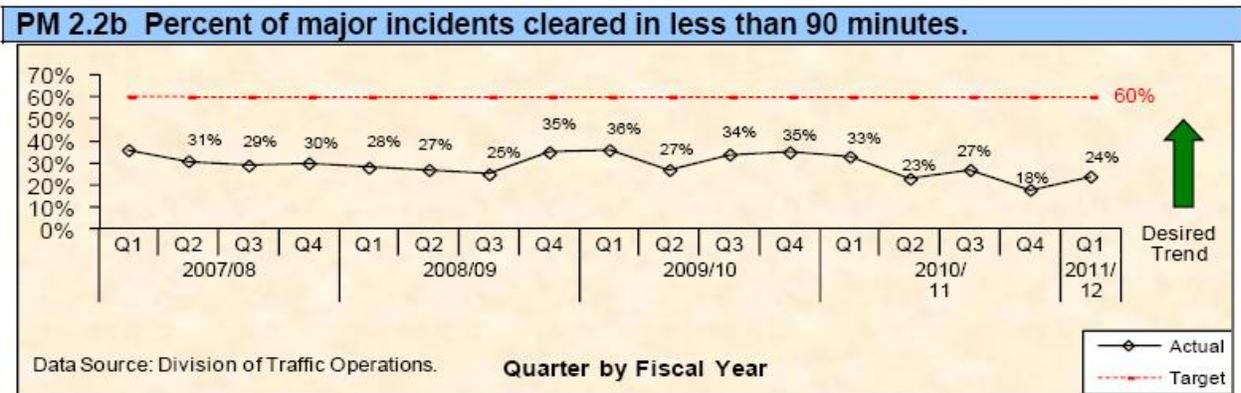


Figure 17: Screenshot of the time series chart that corresponds to the dashboard graphic in Figure 16.

While Caltrans' quarterly report only shows 16 select measures are shown as dashboard indicators, it provides time series charts for all 77 performance measures, except where a measure is new and therefore has no data or where it is under re-evaluation for use as a measure [59].

### 6.3 Communication with Government Officials

Performance data can be used to justify government funding and generates a sense of accountability for funds already dispersed. Therefore, communicating with government officials regarding agency performance is critical. For example:

- At Michigan DOT, results are reported to the Legislature on an annual basis through the work of the Transportation Asset Management Council, which oversees data collection at the state, county, and city levels for roadway and bridges assessment [65]. In this case it is helpful to have a council which is responsible for data collection to ensure that accurate information is presented to government officials.
- Each edition of Washington DOT's Gray Notebook is archived online, with an electronic subject index, and distributed to all legislators, the Governor, the Transportation Commission, interest groups, various jurisdictions throughout the state, and university and research organizations all over the country. This is an excellent example of enabling wide use of performance data.

## 7. Performance Management Best Practices, Lessons Learned and Linkages with Asset Management

### 7.1 Characteristics of Performance Management

The literature findings indicate the performance management has the following characteristics:

1. *Performance measures are aligned with strategic goals for agency effectiveness and efficiency.* If an agency's performance measures are not linked with a strategic planning or strategic management process, it may not be as effective in addressing needs and opportunities as perceived by its external and internal stakeholders. Strategic management ensures that the agency is responding to the perceived needs and opportunities of external and internal stakeholders – it relates to organizational *effectiveness*. On the other hand, performance management is a process for steering the organization to achieve its articulated strategic goals – it relates largely to organizational *efficiency* in achieving strategic goals. An agency that has a strong performance management process without a strong strategic management process may be operating very efficiently but not effectively with respect to addressing the pertinent needs and opportunities as perceived by its stakeholders. An agency, on the other hand, that has a very good strategic management process and a weak performance management process is very much in tune with the needs and opportunities of its stakeholders but not as efficient in achieving them. Basically, an agency must be taking steps to develop strong strategic management and performance management processes.
2. *Performance information is used in decision making to improve the agency's effectiveness.* In order for this to occur, the performance management information must be tied to actions that the agency is able to take. An agency that is engaging in performance management expects to demonstrate steady gains in the benefits accruing from agency decisions (investment and policy); as well as improve the use of performance information in informing political decision makers and demonstrating accountability to external stakeholders.
3. *Performance management includes agency-level as well as unit-level measures.* Organizational or agency-level goals must be well aligned with unit-level measures to ensure that the agency can achieve its articulated goals.
4. *Performance management processes must have designated champions/owners for specific agency measures.* These champions are responsible for keeping track of a particular performance measure or measurement area, and for designing and implementing strategies that result in steady improvement of performance in their designated areas.
5. *Performance management must distinguish between internal measures for tracking agency and system effectiveness versus external measures for*

*publicizing the agency's progress to its external stakeholders.* For effective performance management, the agency must have both internal measures used for diagnosing and managing effectiveness (i.e., clinical or diagnostic measures) and external measures for effectively communicating the state of the system to external stakeholders as well as marketing progress and needs to political decision makers.

6. *Performance management must include both output and outcome measures.* It is important that an agency distinguish between output measures (attributable to the agency) and outcome measures (meaningful to the general public), and these need to be credibly connected. Outcomes may sometimes be more difficult to measure for various reasons. First of all, some outcome measures may incorporate relatively high levels of subjectivity on the part of system users, e.g., the present serviceability rating for pavements is an outcome measure that captures how system users perceive the smoothness of ride on pavements (compared with the pavement condition index, which is an output measure, and can be measured more objectively because it is focused on the pavement itself). Secondly, it is also important to choose the right level of aggregation to capture the particular outcome of interest at an aggregate enough level to be actionable, but disaggregate enough to capture differences in outcomes among different population segments. Thirdly, it is important to formulate measures that are actionable. In addition, the performance outcomes data may only be influenced in part by agency actions (i.e., there may be other influences). This makes it necessary to ensure that there is a linkage between outputs and outcomes to help with the attribution of agency actions with observed outcomes.
7. *Agencies must consider how they can use performance information to appeal to the general public and political decision makers.* This is important for attracting and retaining financial resources. One strategy for this is to highlight exciting projects within performance reports, demonstrating how these projects can improve performance of the system or the agency in a manner that pertains to the system users' experience. Such information must be easily accessible and understood by those who are interested in it. It must also be detailed enough to be personally relevant to system users and other stakeholders.

## 7.2 International Best Practices in Performance Management

The following six agencies, each with over a decade or more of experience in performance management, were visited in an international scan on performance management conducted by the FHWA with support from AASHTO in 2010 [66]:

- Swedish Road Administration
- British Department of Transport and Highways
- New South Wales Roads and Traffic Authority
- Victoria Department of Transport and Vic Roads
- Queensland Department of Transport and Main Roads
- New Zealand Ministry of Transport and New Zealand Transport Agency

The following key findings characterized the agencies then:

1. While there was a clear linkage between government expenditures and agency results; agencies had found it relatively difficult to use agency results to influence budgetary decisions (i.e., performance-driven allocations is a difficult goal to achieve);
2. Agencies had found that ambitious goals and visions drive investment more so than performance management information; the public is more likely to get behind projects that they can be excited about and thus marketing is critically important. Along the same lines, there may therefore be a place for dual systems of reporting with candid, confidential reporting done for the purposes of diagnosis and improvement rather than simply informing the public.
3. Incentive-based systems were preferred to penalty-based systems.
4. The true value of performance management had been found in achieving steady long-term progress over time. Agencies had found that short-term results can be overemphasized.
5. Performance management was seen as a tool for documenting accountability
6. Performance management systems dovetailed with asset management systems.
7. Value-for-money was a common theme with several agencies using benefit/cost analysis.
8. There was a limited number of high-level measures for all agencies.
9. Dialogues were preferred over dictates in the intergovernmental management of performance. "Do it with people; not to them" had been found to be an effective approach in intergovernmental performance management.
10. Agencies had found that performance management takes time and resources.
11. Outcomes that relate to the public in personal terms were important; however, outcomes were also difficult to measure.
12. Highway corridors remain important despite strong commitment to multimodalism and in some cases reorganization and refocus from building highways to moving people.
13. There was found a strong focus on safety with agencies emphatic about documenting safety result
14. Measures were used to drive operations innovations

15. There was a strong commitment to sustainability with mobility – to addressing climate change and sustainability through transportation investments.

### 7.3 Current Practice in State DOTs: Strategic Management, Asset Management and Performance Measurement/Management

A survey sponsored by Georgia Department of Transportation from September 2009 to February 2010 and conducted by Georgia Institute of Technology reviewed best practices in performance measurement and asset management practices in state DOTs [67]. With 78% response rate, the survey indicated the following:

1. Over 90% (36 of 39) of the respondents reported that they had a strategic plan in place and about 33% (13 of 39) reported that they update their plan annually.
2. More than half of the responding agencies (23 of 39) reported that they had tied their performance measures to their strategic goals and objectives.
3. The responding DOTs reported that strategic objectives are largely related to transportation system safety, system preservation and mobility, and to a lesser extent to employee and organizational development, customer satisfaction, economic growth and vitality, and environmental quality.
4. About 70% (28 out of 39) of the responding agencies reported that performance measures are mostly used in management and planning, and not in all DOT functions. About half (21) of the responding DOTs reported that they use performance measures in operations, and slightly under half (18) in design and engineering.
5. About 80% (30 out of 39) reported that they use performance measures to engage stakeholders (the public, legislature, governor and industry) Common ways of engagement included customer satisfaction surveys, focus groups, public meetings and hearings and websites.
6. Just over 80% (31 out of 39) reported that they set performance targets using a wide variety of approaches including upper management or program managers deciding, funding levels driving targets, benchmarking, stakeholder input, consensus, historical data and/or past experience, customer or public input, and engineering judgment.
7. About 70% (27 out of 39) DOTs reported that they have an asset management program in place with most programs being used to monitor the condition of highways and bridges. Few agencies reported that they had a well-integrated system where their whole planning process is focused on asset management.

8. The survey showed that various state DOTs have different levels of capabilities with respect to strategic planning and management, asset management and performance management, setting the stage for further development of full-fledged performance management processes -- as MAP-21 measures get developed for implementation.

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# Leading Practices in Organizational and Systems Performance Management in State DOTs

## Volume I: STATE DOT BENCHMARKING STUDY

### Appendix B: IN-DEPTH CASE STUDIES

Project Title

Transportation Asset Management: Organizational Performance and Risk Review

Submitted to

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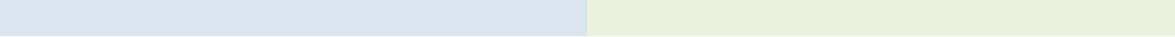
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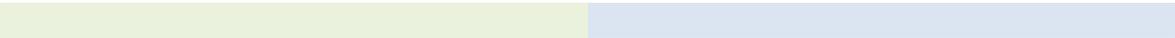
Updated November 15, 2012

# Table of Contents

- I. Midwestern States.....B3**
  - 1. Kansas \*‡ .....B4
  - 2. Michigan.....B9
  - 3. Minnesota \*‡ .....B14
  - 4. Missouri \*‡ .....B20
  - 5. Montana .....B24
  - 6. Texas‡ .....B28
- II. Eastern States .....B32**
  - 7. Connecticut .....B33
  - 8. Florida .....B38
  - 9. Maryland\*‡.....B42
  - 10. Virginia\*‡ .....B45
  - 11. Georgia\* .....B49
  - 12. North Carolina‡ .....B53
- III. Western States .....B57**
  - 13. California\*‡ .....B58
  - 14. Oregon\*‡ .....B63
  - 15. Utah‡ .....B69
  - 16. Washington\*‡.....B75
  - 17. New Mexico° .....B81
  - 18. Colorado \*‡ .....B83



### **III. Midwestern States**



# 1. Kansas \*‡

## 1.1 Measures Used and Current Framework

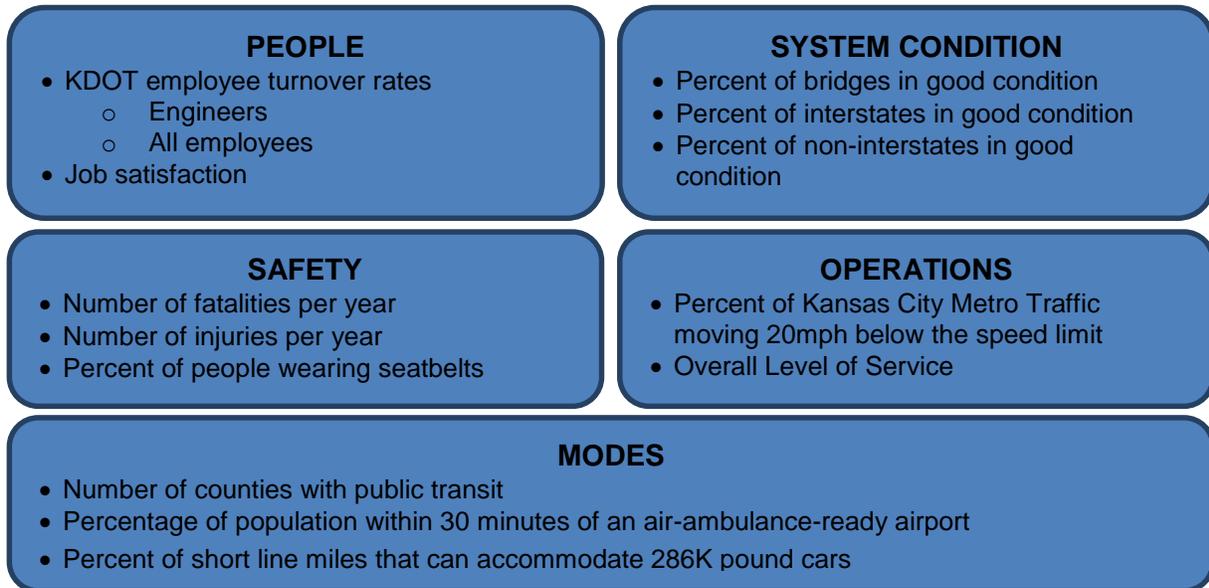
Kansas DOT describes thirteen critical success factors that define successful system performance, organizational performance, and customer satisfaction:

**Table 1: KDOT Critical Success Factors**

<p><u>System Performance</u></p> <p><b>KDOT is successful at providing a statewide transportation system to meet the needs of Kansas when:</b></p> <ol style="list-style-type: none"> <li>1. The overall physical condition of the State Highway System (SHS) improves or remains at a favorable condition.</li> <li>2. We are able to manage added traffic and access demands on the SHS without significant decreases in service level.</li> <li>3. The annual highway accident and fatality rates decrease or remain the same on the SHS.</li> <li>4. Public transportation systems show a positive trend in service.</li> <li>5. The physical condition of public-use airports shows favorable improvement.</li> <li>6. The physical condition of the shortline railroad infrastructure allows for the safe and efficient movement of commodities throughout the state.</li> </ol>
<p><u>Organizational Performance</u></p> <p><b>KDOT is successful as an organization when:</b></p> <ol style="list-style-type: none"> <li>1. We meet schedules and budgets for construction programs.</li> <li>2. The cost of agency operations remains at or below the current (baseline) level, factored for inflation.</li> <li>3. Legal actions against the agency are at or below the current (baseline) level.</li> <li>4. Our employees are safe, productive, and effective and have a sense of personal fulfillment.</li> </ol>
<p><u>Customer Satisfaction</u></p> <p><b>KDOT is successfully satisfying our customers when:</b></p> <ol style="list-style-type: none"> <li>1. The public is satisfied with the provided level of service.</li> <li>2. KDOT and its business partners have a win- win relationship.</li> <li>3. The public perceives the department is providing valuable services for their tax dollars.</li> </ol>

These success factors imply the need for performance measures related to asset management, traffic and public transport operations, safety, program and project delivery, legal actions, human resources, and stakeholder perception. Currently, KDOT reports performance measures related to some but not all of these areas. Performance measures are updated quarterly or annually, depending on the nature of the measure,

and they are reported KDOT’s performance measures website. The performance measures are organized according to five functional categories: Safety, System Condition, People, Operations, and Modes. These performance measures are tied to three general priorities from the Long Range Transportation Plan: to preserve the system, make travel safer, and support economic growth. The five categories of measures are listed in Figure .



**Figure 1: KDOT Performance measures by functional category (Source: KDOT Final Report)**

KDOT also uses several budgetary and program delivery performance measures, which are monitored and managed using a new program called T-Works. The purpose of T-Works is to ensure on-time and on-budget project delivery and to serve as a medium for reporting budget and project delivery performance data.

1.2 Measuring Progress toward Strategic Goals

Beyond the general priorities mentioned in KDOT’s long-term plan, the agency’s Strategic Plan identifies six strategic goals:

1. “Program Delivery – KDOT will successfully complete the Comprehensive Transportation Program (CTP) on time and on budget.
2. “Organizational Improvement – KDOT will continually improve as an organization.
3. “External Relationships – KDOT will build relationships with all of its non-governmental external customers and partners.
4. “Workforce – KDOT will successfully maximize the effectiveness of its workforce;
5. “Technology – KDOT will optimize its use of technology to improve the efficiency and effectiveness of the department’s operations.

- 6. “Intergovernmental Relationships – KDOT will build on its relationship with all its intergovernmental customers and partners.”

The strategic goals and objectives are updated annually, while measures and targets are updated quarterly.

In addition to its “strategic goals,” KDOT defines four “management goals,” which include: Leadership, Local Multimodal Assistance, Highway Maintenance, and Highway Project Development and Construction. Economic development and safety are also strategic goals, which the agency will add to its next strategic plan. Measures do not exist for all strategic goals, only “leadership”, “local multimodal assistance”, “highway preservation”, “highway project development and construction”, “economic development”, and “safety”.

### 1.3 Using Performance Information in Decision Making

All strategic goals and objectives that have measures associated with them are linked to actions within KDOT. Specifically, pavement condition and joint condition ratings are used when selecting road and bridge projects, respectively. Also, one of the purposes of the new T-Works system is to encourage economic development by allowing for greater stakeholder input and flexibility in project selection; this indicates that the performance information provided to T-Works users may indirectly affect project selection because those same users provide feedback into the selection process.

### 1.4 Performance Management in the Organization Structure

Each performance measure has an owner from a specific KDOT division, bureau, or office. For example, a Bridge Management Engineer is the owner of the bridge condition measure. A Performance Measures Manager was hired in 2011 to oversee the performance measurement program. There are 10 functional units that play a role in performance management: Office of the Secretary, Division of Financial Services, Chief Council, Inspector General, Division of Administration, Division of Engineering and Design, Division of Operations, Bureau of Construction and Maintenance, Division of Aviation, and Division of Planning Development. Top management and the Office of the Secretary are responsible for defining strategic goals and objectives, while mid-level management defines measures and targets and perform the analyses. Many of the other functional units play an occasional role in defining measures and targets.

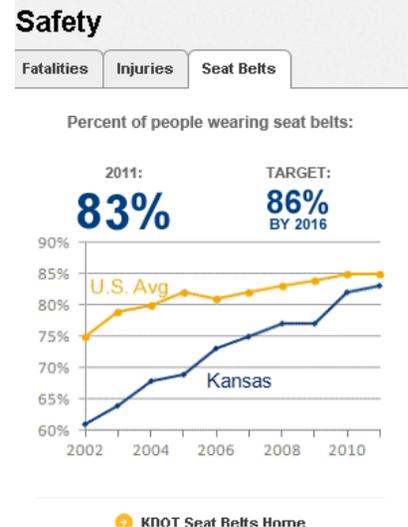


Figure 2: Graphical element of seatbelt use (Source: KDOT Performance Measures website)

1.5 Reporting

KDOT utilizes a graphic reporting style for public use on their performance measurement website. As shown in Figure 2, each entry shows change in performance over time, and (where applicable) associated performance targets. Some benchmarks are also presented; for example, seatbelt use is compared to the U.S. average by displaying it along with the KDOT data on a line graph (Figure 2).

T-Works incorporates interactive maps to assist in searching for current projects (Figure 3), and KDOT also provides a live-fed road condition map online to assist with trip planning.

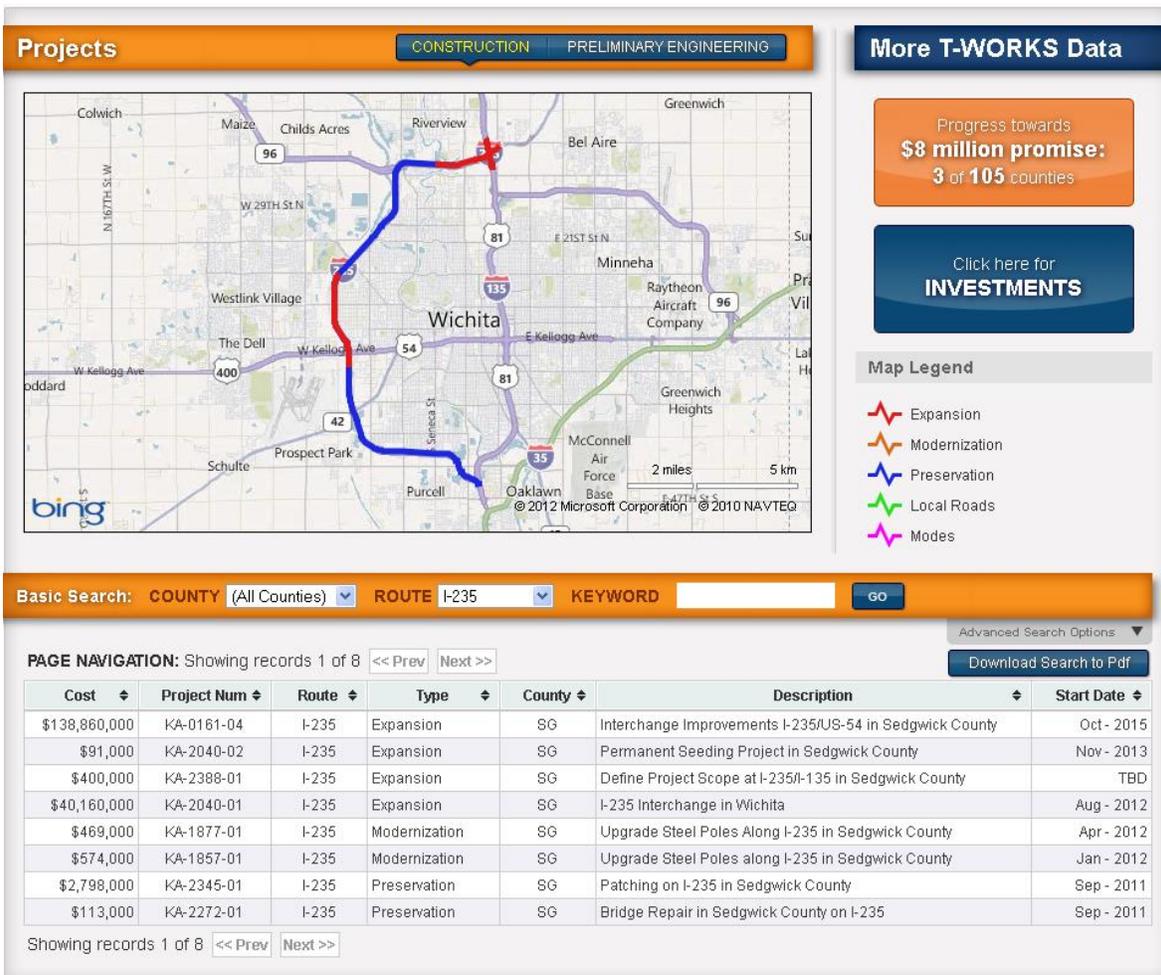


Figure 3: T-Works project data (Source: T-Works website)

Sources

- Partnership Project transitions into Phase II: Enter Performance Measures <http://www.ksdot.org/Partner/Linking%20Performance%20Measures%20to%20P2.pdf>
- T-Works website <http://www.ksdot.org/t-works/>

- KDOT Performance Measures website <http://kdotapp.ksdot.org/perfmeasures/>
- KDOT Strategic Plan <http://www.ksdot.org/offmangbudg/smp/KDOTstraplan.asp>

\* In addition to publicly available documents, this case study was augmented using information from an interview with KDOT's Performance Measures Manager (April 25, 2012).

‡ This case study has been reviewed for by KDOT's Performance Measures Manager.

## 2. Michigan

### 2.1 Measures Used and Current Framework

MDOT monitors several performance measures that are tied to four strategic goal areas that come from the State’s Long Range Plan, which also are the basis for the performance measurement framework. These strategic goal areas and associated measures are shown below in Figure 4.

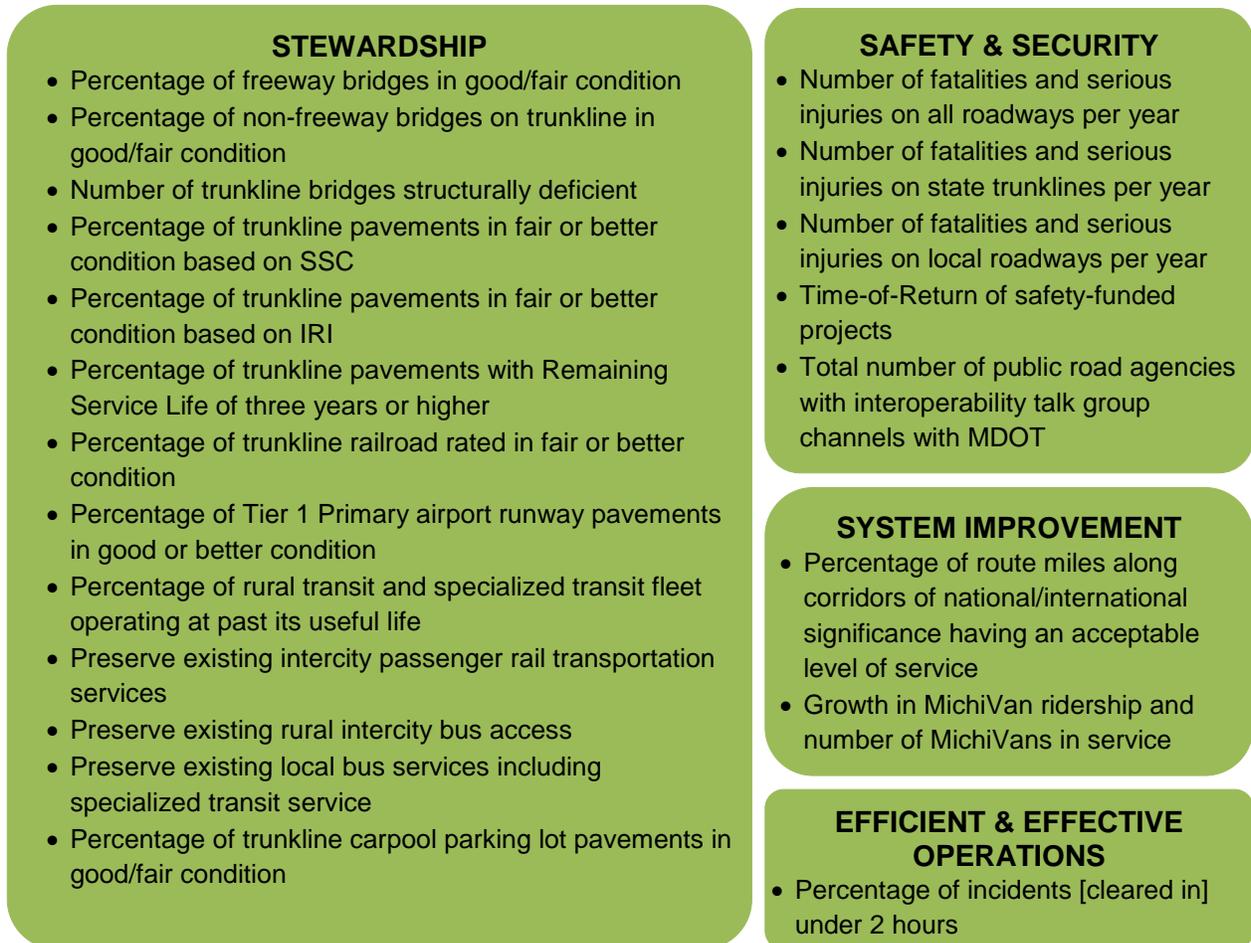


Figure 4: MDOT performance measures and functional categories (Source: MDOT Performance Measures Report 2012)

### 2.2 Measuring Progress toward Strategic Goals

The goal areas of performance measures identified by MDOT are directly linked to four high-priority goals from the long range plan. The high-priority goals are defined in MDOT’s 2010 report Driven by Excellence, as follows:

- Stewardship – Preserve transportation investments, protect the environment, and utilize public resources in a responsible manner

- Safety and Security – Continue to improve transportation safety and ensure the security of the transportation system
- Serving Customers – Modernize and enhance the transportation system to improve mobility and accessibility
- Efficient and Effective Operation – Improve the efficiency and effectiveness of the transportation system and transportation services and expand MDOT’s coordination and collaboration with partners

### 2.3 Using Performance Information in Decision Making

According to the MDOT document, “Driven by Excellence”, several performance measures are used in asset management decision making. Existing conditions are compared to targets using an outcome-based deficiency analysis. This is done using an automated decision-support tool is called the Transportation Management System (TMS). The TMS allows MDOT to “identify the condition of an asset, analyze usage patterns, and determine deficiencies of the transportation infrastructure”. MDOT also uses TMS to manage mobility by measuring service-related aspects of the transportation system. There are six elements to TMS: bridge, congestion, intermodal, pavement, public transportation, and safety management systems. The performance measures listed in Figure 4 have been integrated into TMS to various degrees.

### 2.4 Performance Management in the Organizational Structure and Processes

- The Michigan Transportation Asset Management Council (TAMC) is a legislated body of agency representatives responsible for data collection at the state, county, and city levels for roadway and bridges assessment and the reporting of these data and analyses to the Legislature and State Transportation Commission. There are three committees under the TAMC: the Administration and Education, Bridge, and Data committees.
- To create the latest Transportation System Condition Report, teams of MDOT staff were assigned to the four strategic goals introduced previously. They selected key outcomes to measure that are tied to these goals, analyzing all the measures and the quality of the data that supports them. The resulting measures were included in the 2010 report. The teams are also responsible for collecting, reviewing, and reporting the data for the Transportation System Performance Measures website, which is updated on a quarterly basis.

### 2.5 Reporting

MDOT publishes an online, interactive Transportation System Performance Measures report that presents performance information using a combination of text and graphics. The report can be navigated using two alternative organizations of measures: by strategic goal area (as shown in Figure 4), and by functional purpose (for example, “Trunkline Bridges,” “Passenger Transportation,” and “Risk/Vulnerability”). The report provides each measure’s aim, definition, target, current status, last reported status, and a time series

graph with targets and actual and projected data (Figure 5). A condition trend table is also available, displaying each measure’s progress since the last quarter and last five years, as well as whether or not its target is currently being met (Figure 6).

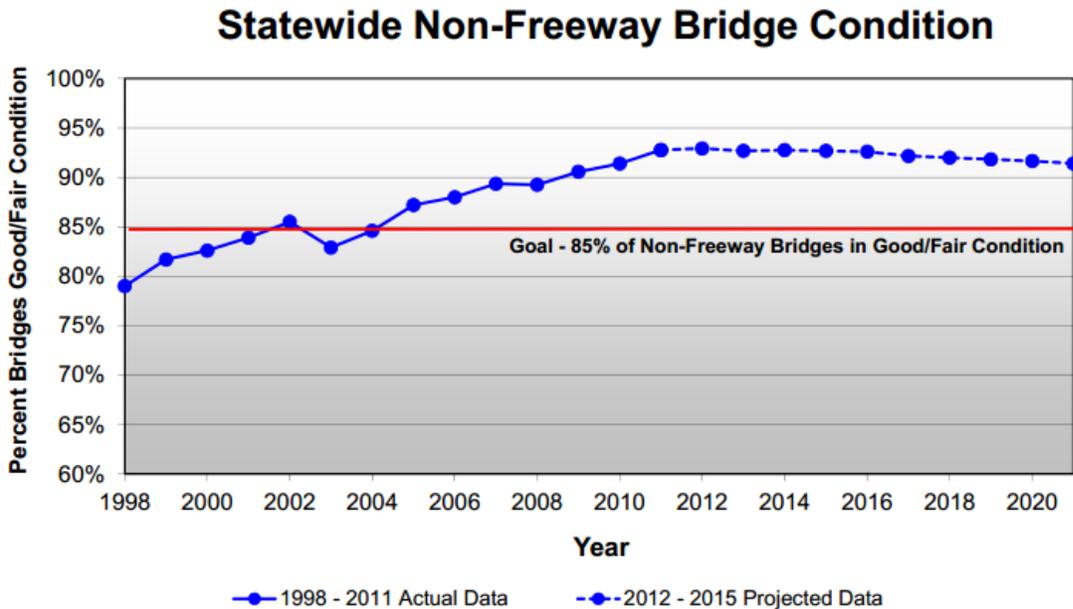


Figure 5: Example of MDOT’s time-series graphic (Source: MDOT Performance Measures Report 2012)

MDOT also publishes or contributes to several other performance-related reports, which are easily accessible from web links on the MDOT homepage:

- The “Infrastructure Dashboard” (part of the “Open Michigan” initiative) provides a concise summary of infrastructure-related performance measures in five categories:
  - Economic Growth – measures relate to commercial and freight traffic
  - Safety – measures relate to fatalities and injuries
  - Accountability – measures relate to on-time and on-budget project delivery
  - Mobility - measures incident clearance and transit ridership
  - Conditions – structural integrity and pavement condition
- The “Transportation Scorecard” (part of the MiScorecard Performance Summaries initiative) reports performance measures in the same categories as the “Infrastructure Dashboard,” plus the following additional categories:
  - Customers
  - Financial Health
  - Environmental Stewardship
  - Employees
- The 44-page “Driven by Excellence” report (2010) describes major projects and programs that have been completed or are underway at MDOT. This report uses full color photographs, quotations from stakeholders, and narrative-style writing to demonstrate MDOT’s accomplishments to a public audience.

- The 2-page “Efficiencies and Innovations” report (2012) describes “numerous efforts to operate more efficiently and find every available dollar in its budget for infrastructure.” “Efficiencies” are activities that have already saved MDOT money, for which the report lists dollar amounts saved through various activities. “Innovative cost-saving measures” are currently being undertaken, for which MDOT has not yet quantified the benefits.

**Condition Trends for All Measures as of February 2012** (All measures are links.)

Measure (Click on a measure to get more information.)	Status	Change from Last Report	Change over Last 5 Years
Freeway Bridge Condition	Green	↑	↑
Non-freeway Trunkline Bridge Condition	Green	↑	↑
Reduction of Structurally-deficient Trunkline Bridges	Green	↑	↑
Trunkline Pavement Condition Based on Sufficiency	Yellow	↔	↔
Trunkline Pavement Condition Based on International Roughness Index	Green	↑	↔
Trunkline Pavement Condition Based on Remaining Service Life	Green	↓	↑
Trunkline Railroad Crossings	Green	↑	Not Available
Tier 1 Airport Primary Runway Pavements	Yellow	↓	↑
Rural and Specialized Transit Fleet Condition	Red	↓	↔
Level of Intercity Passenger Rail Services	Green	↑	↔
Rural Intercity Bus Access	Green	↔	↔
Level of Local Bus Transit Services	Green	↔	↑
Carpool Lot Condition	Green	↔	↑
Statewide Crash Severity Reduction	Green	↑	↑
Trunkline Crash Severity Reduction	Green	↑	↑
Local Roadway Crash Severity Reduction	No Standard	↑	↑
Safety-funded Project Return on Investment	Green	↔	↑
Road Agencies Serviced with Interoperable Communication Equipment	No Standard	↑	Not Available
Percentage of Program Dollars Spent on Protective Efforts	Green	↔	↔
Acceptable Level of Service on (Inter-)Nationally Significant Corridors	No Standard	↓	↑
Michivan Access Expansion	Green	↔	↑
Manage Traffic Incidents Timely	Green	↓	Not Available

<b>GREEN</b>	Current status is at 90% or greater of target
<b>YELLOW</b>	Current status is between 75% and 90% of target
<b>RED</b>	Current status is less than 75% of target

↑	Condition Improving
↓	Condition Declining
↔	Condition Staying About the Same

**Figure 6: MDOT's condition trend table (Source: MDOT Performance Measures Report 2012)**

Sources

- MDOT System Performance Measures Report (2012) Accessed: September 2012. [http://www.michigan.gov/documents/mdot/MDOT-Performance Measures Report 289930 7.pdf](http://www.michigan.gov/documents/mdot/MDOT-Performance_Measures_Report_289930_7.pdf)

- Driven by Excellence: A Report on Transportation Performance Measurement at MDOT (2010)  
[http://www.michigan.gov/documents/mdot/MDOT\\_DrivenExcellenceReport\\_323894\\_7.pdf](http://www.michigan.gov/documents/mdot/MDOT_DrivenExcellenceReport_323894_7.pdf)
- Transportation Asset Management Council – MI Transportation Reporting Portal (2007)  
[http://www.mcgi.state.mi.us/mitrp/Council/Default\\_Council.aspx](http://www.mcgi.state.mi.us/mitrp/Council/Default_Council.aspx)
- MDOT Asset Management website (2012)  
[http://www.michigan.gov/mdot/0,4616,7-151-9621\\_15757-25283--,00.html](http://www.michigan.gov/mdot/0,4616,7-151-9621_15757-25283--,00.html)
- MDOT Efficiencies and Innovations report (2012)  
[http://michigan.gov/documents/mdot/MDOT\\_EfficiencyFINAL\\_377416\\_7.pdf](http://michigan.gov/documents/mdot/MDOT_EfficiencyFINAL_377416_7.pdf)

### 3. Minnesota \*\*‡

#### 3.1 Measures Used and Current Framework

The Minnesota Statewide Policy Plan, *Your Destination ... Our Priority*, identifies ten major policy areas to which it links its performance measures, as listed in Figure 7.



Figure 7: MnDOT performance measures and goal categories (Source: *Your Destination ... Our Priority Minnesota Statewide Policy Plan 2009-2028, Annual Minnesota Transportation Performance Report 2009*)

Most of the measures listed in *Your Destination...Our Priority* were reported in MnDOT’s annual performance report each year since the plan’s publication in 2009; only the “accountability and transparency” measure was not reported after 2009.

A new long range plan, the *Minnesota GO Statewide Multimodal Transportation Plan*, was released in September 2012. Instead of the ten policy areas defined by *Your Destination ... Our Priority*, the *Minnesota GO* plan lists six objectives:

1. Accountability, Transparency, and Communication
2. Traveler Safety
3. Transportation In Context
4. Critical Connections
5. Asset Management
6. System Security

Future annual performance reports will be redesigned based on the objectives of *Minnesota GO*.

3.2 Measuring Progress toward Strategic Goals

MnDOT has five “strategic directions” that form the foundation for its major policy objectives, each of which is associated with particular measures, as shown in Table 2.

**Table 2: MnDOT's strategic directions and associated measurements of progress and success, from the *Your Destination...Our Priority* Strategic Plan website**

<b>Strategic Direction</b>	<b>Measurement of progress or success</b>
1. Safety – Promote and maintain a safe, reliable, and modern transportation system	<ul style="list-style-type: none"> <li>• Measuring the number of fatalities and serious injuries on all state and local roads.</li> </ul>
2. Mobility – Improve access and enhance the movement of people and freight	<ul style="list-style-type: none"> <li>• Tracking national and global connections which include non-stop air destinations from Minnesota and port tonnage moving in and out of the Great Lakes and rivers</li> <li>• Assessing statewide connections including average speeds along interregional corridors in Greater Minnesota and airport access</li> <li>• Reviewing Minneapolis and St. Paul's mobility including freeway congestion, clearance time after freeway accidents and annual express transit ridership</li> <li>• Evaluating Greater Minnesota bus service hours and short line railroad track speed</li> </ul>
3. Innovation – Promote a culture of innovation in the organization	<ul style="list-style-type: none"> <li>• Using employee surveys to determine whether MnDOT's workplace culture fosters innovation</li> <li>• Polling key external stakeholders to determine their perception of MnDOT's success in innovation.</li> </ul>
4. Leadership – Become the transportation leader and employer of choice for Minnesota’s diverse population	<ul style="list-style-type: none"> <li>• Measuring ethnic and gender characteristics of new hires and the overall MnDOT workforce</li> <li>• Surveying employees to determine their engagement in MnDOT's core businesses</li> <li>• Assessing key external stakeholders to determine their perception of MnDOT's role as a transportation leader</li> </ul>

<p>5. Transparency – Build public trust in MnDOT</p>	<ul style="list-style-type: none"> <li>• Surveying our customers to determine their trust and confidence in MnDOT</li> <li>• Tracking the successes at delivering projects on time and on budget</li> <li>• Monitoring the results of managing our capital, operational and project budgets</li> <li>• Regularly reporting the number of on-the-job placements of minority and female applicants with MnDOT contractors and the number of Disadvantaged Business Enterprises participating in MnDOT's federal projects</li> </ul>
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Not all of the “measurements of progress” listed in Table 2 are reported in MnDOT’s *Annual Transportation Performance Reports*. The annual performance reports only include measures related to the transportation system, and therefore exclude the measures related to innovation, leadership, and transparency.

Of those measures that are reported in its 2011 *Annual Transportation Performance Report*, MnDOT differentiates between phenomena for which it has primary responsibility (or significant influence), and other phenomena that it simply tracks for contextual information. For all of the measures over which it has primary responsibility, and some of the other measures, MnDOT designates numerical targets. Measures without targets are designated “tracking indicators.” All reported measures, whether associated with targets or not, are still associated with a desirable trend direction (increasing or decreasing).

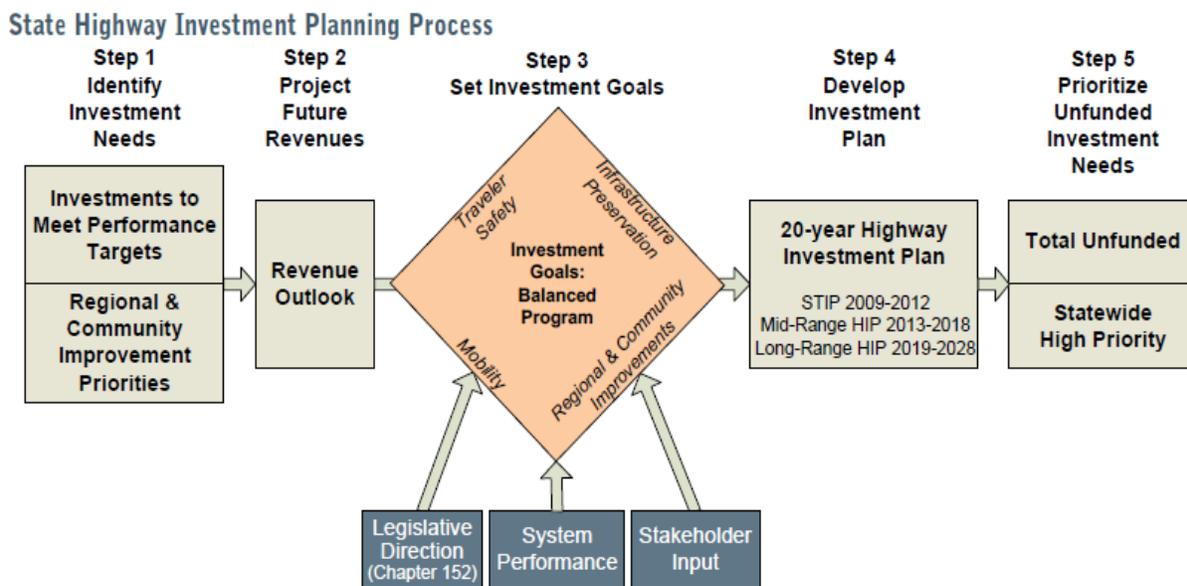
3.3 Using Performance Information in Decision Making

MnDOT links performance data to decision making by using it in a variety of ways. The decision making process associated with each measurement area is described in the *Annual Transportation Performance Report*. Examples include:

- The Office of Traffic, Safety and Technology works as part of the Toward Zero Deaths coalition coordinating common planning strategies, performance measures and decision-making criteria statewide.
- The Bridge Office uses performance data such as a bridge’s age, its structural condition rating, its repair and reconstruction history, and the traffic level affected by any construction or repair activity to determine whether a bridge should be repaired or replaced.
- Maintenance engineers and supervisors use performance results from snow plows to make operations decisions for scheduling during the snow season.
- Every year the Materials Office uses condition data for all state roads to recommend improvements, maintenance, and replacements to MnDOT’s eight districts. When funds are available, districts with a high percentage of roadways that do not meet the targets are expected to invest more in improvements.
- Congestion performance data are used to evaluate mitigation options. Corridor-by-corridor measurement of travel speed, throughput of vehicles, and crashes are used to help identify needs.

- Intersections are prioritized for conversion to ADA accessible pedestrian signals using pedestrian and transit data and characteristics of surrounding development.
- An intergovernmental group called Team Transit is responsible for making investment decisions regarding transit corridors in the Twin Cities Area. Team Transit includes a representative from MnDOT’s Metro District planning office along with representatives from Metro Transit and other transit operators in the Minneapolis - St. Paul region. The group makes transit investment decisions by determining each corridor’s current and needed number of buses and congestion level.

A flow chart of the State Highway Investment Planning Process is shown in Figure 8.



**Figure 8: Minnesota Highway Investment Planning Process (Source: 2008 Annual Transportation Performance Report)**

3.4 Performance Management in the Organizational Structure and Processes

MnDOT includes a Performance Planning and Measurement Unit comprised of two analysts, an engineer, planner, and program administrator. They are responsible for publishing the *Annual Transportation Performance Report*. This unit is part of the office of Capital Programs & Performance Measures, which is one of seven offices within the Modal Planning & Program Management Division. MnDOT includes six divisions total, all of which report to the Deputy Commissioner and Chief Engineer. All six divisions play a role in the performance management process. Top management work with each division to define strategic goals and objectives, while mid-level management defines the measures and set the targets. Occasionally, mid-level management will be involved in the analysis, but this is primarily conducted at the division level.

3.5 Reporting

MnDOT’s *Annual Transportation Performance Report* has evolved and become more refined in its presentation since the first edition in 2008. The 2011 edition includes a section on performance highlights, an overall scorecard of the system, and in-depth discussions regarding each performance measurement area.

- The performance highlights section identifies performance strengths, gains, weaknesses, and challenges of the past year and how some of these factors have influenced economic competitiveness.
- The results scorecard organizes measures according to major policy areas. Each measure is shown with its corresponding target and is scored using traffic signal colors to indicate whether the measured value is at or above target, moderately below target, or seriously below target. A four-year trend is shown for each measure, along with an analysis of the measure’s performance. Some scorecard entries also compare MnDOT’s performance to national trends or other states.
- For each measurement area, two pages of information describe the scope of individual measures, and their relevance to the MnDOT system, as well as an analysis of the progress toward reaching the set targets, current efforts and strategies, and related investments and decision-making processes. There are also time series charts that include trends, targets, and predicted trends up to 2015. Figure 9 shows an example of this for bridge condition.
- MnDOT compares many of its performance measures and tracking indicators to other states or the national average.
- For many performance measurement areas, the 2011 report highlights examples of MnDOT initiatives with “high return on investment.”

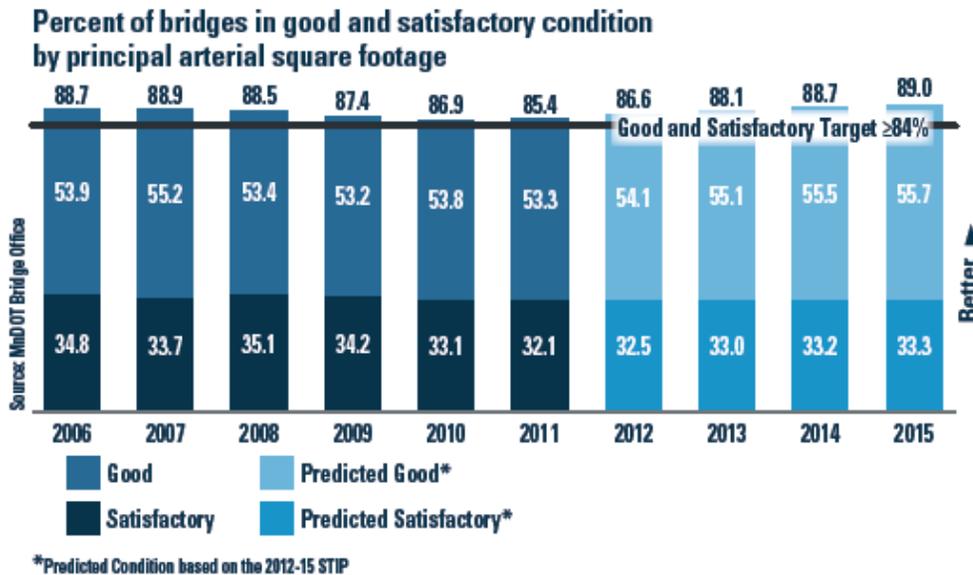


Figure 9: MnDOT time series chart with trends, targets, and predicted trends (Source: 2011 *Annual Transportation Performance Report*)

Sources

Annual Minnesota Transportation Performance Report (2010)  
<http://www.dot.state.mn.us/measures/pdf/2010pm10-6.pdf>

Minnesota Statewide Transportation Policy Plan (2009-2028)  
<http://www.dot.state.mn.us/planning/stateplan/download.html>

Annual Minnesota Transportation Performance Report (2008)  
<http://www.dot.state.mn.us/measures/pdf/2008%20MnDOT%20Performance%20Report.pdf>

\* In addition to publicly available documents, this case study was augmented using information from an interview with analysts in MnDOT's Performance Planning and Measurement Unit (April 26, 2012).

‡ This case study has been reviewed by MnDOT's Performance Planning and Measurement Unit.

## 4. Missouri \*\*

### 4.1 Measures Used and Current Framework

MoDOT has more than 100 performance measures cited in its most recent performance report, *Tracker*. These measures are organized according to 19 “tangible results.” Figure 10 provides example measures associated with a sample of tangible results.

### 4.2 Measuring Progress toward Strategic Goals

MoDOT’s “tangible results” function as strategic goals for the agency. The performance measures used by MoDOT are directly linked to its tangible results, thereby providing a mechanism to track progress. MoDOT also defines a desired trend (increasing or decreasing) or a numerical target (for example, 10-minute travel time for 10 miles on selected freeway sections), for each one of its performance measures. This provides a point of comparison for tracking progress toward tangible results.

### 4.3 Using Performance Information in Decision Making

In a cover statement to the *Tracker* report, MoDOT’s director indicates that the agency’s defined Tangible Results “guide us in making decisions every day.” The role of performance information in MoDOT’s decision-making process is illustrated by a few entries throughout *Tracker*. For example:

- MoDOT randomly selects slightly more than half of its signalized arterial highways each year, measuring the rate of travel on each. This data is used to identify arterials with high, medium, and low levels of mobility (travel speed is 80% of the speed limit, 50-79%, or less than 50% respectively). Although the *Tracker* report does not explicitly state that this information is used to select projects for improving travel flow, MoDOT does track the rate of travel on these routes “as improvements such as signal timing or access management are made” in order to show the effects of such decisions.
- MoDOT is “proactively identifying and disposing of property that is no longer needed for the maintenance of the transportation system, will not be used for future expansion projects and is no longer needed for its operations.” The agency then tracks and reports the “number of excess properties conveyed and gross revenue generated from excess properties conveyed.” As explained in *Tracker*, “Funds received from the conveyance of excess properties are used to improve the condition of the state highway system,” and “The districts... apply [these funds] toward the costs associated with construction projects.”
- One of MoDOT’s tangible results is the inclusion of customers’ needs in decision-making. Stakeholder comments, from the public and from planning partners, can be considered a type of performance information.

In addition to these specific examples, every one of the performance measures listed in *Tracker* is analyzed in terms of its “Improvement Status.” Several of the discussions of “Improvement Status” highlight actions taken by MoDOT, which have contributed to

changed performance over time, thereby implying that these decisions were taken consciously in order to improve performance.

#### 4.4 Performance Management in the Organizational Structure and Processes

Responsibility for performance measures is broadly dispersed throughout the agency. Each performance measure reported in *Tracker* has a “result driver” and “measurement driver”—employees who are charged with achieving results and recording measurements, respectively. Several of the measures have result and measurement drivers from different functional units within the agency. For instance, the measure “dollars saved for Bolder Five-Year Direction priorities” has an assistant chief engineer as the result driver and a financial resource administrator as the measurement driver. This sort of structure can increase communication and coordination across functional units and provides for a horizontally integrated performance management program.

The performance management process at MoDOT takes a “grass-roots” or “bottom-up” approach, as front-line employees are involved at the division and district level. Every functional unit within MoDOT deals with *Tracker*, and each division and district also uses its own *D-Tracker* for internal measurement and management. In addition to the *Tracker* and *D-Trackers*, MoDOT also produces an internal document, the *Supplement*, which provides comparative performance information about the agency’s divisions and districts. Based on this intra-agency benchmarking in the *Supplement* and other performance information in the *D-Trackers*, all employees receive feedback from their managers about performance outcomes at least twice per year.

MoDOT holds a quarterly meeting to review *Tracker* results with approximately 125 people including commissioners, FHWA, executive leadership, senior managers, measurement drivers, and one or two employee guests from each division and district. Measurement drivers report during the meeting on what efforts were made in the last quarter to improve the performance of their particular performance measure(s).

#### 4.5 Reporting

MoDOT has been providing quarterly performance reports to its management since 2001. Today, the agency produces the publicly-available *Tracker*, a quarterly performance report that describes the purpose, the measurement and data collection processes, the performance target, and improvement status for each performance measure tracked by the agency. For each measure, a time series chart illustrates the average measurement value over several years. Some measures also include other graphical displays, such as a color coded map for the measure “average travel time on selected freeway sections” that depicts high, medium, and low mobility corridors. Sample images from *Tracker* are shown in Figure 11.

MoDOT uses benchmarking to gauge performance. For example, MoDOT benchmarks its performance in pavement condition to another state (Georgia) with comparable mileage on its highways. MoDOT also compares its bridge condition performance to

Ohio’s, and it compares annual system fatalities to the national average. Also mentioned in Tracker, “MoDOT’s continuing efforts to be open and transparent... [include] a variety of outreach activities ranging from the Traveler Information Map and social media communications to public meetings and media and personal contacts.”



**Figure 10: MoDOT sample of performance measures and goal categories**

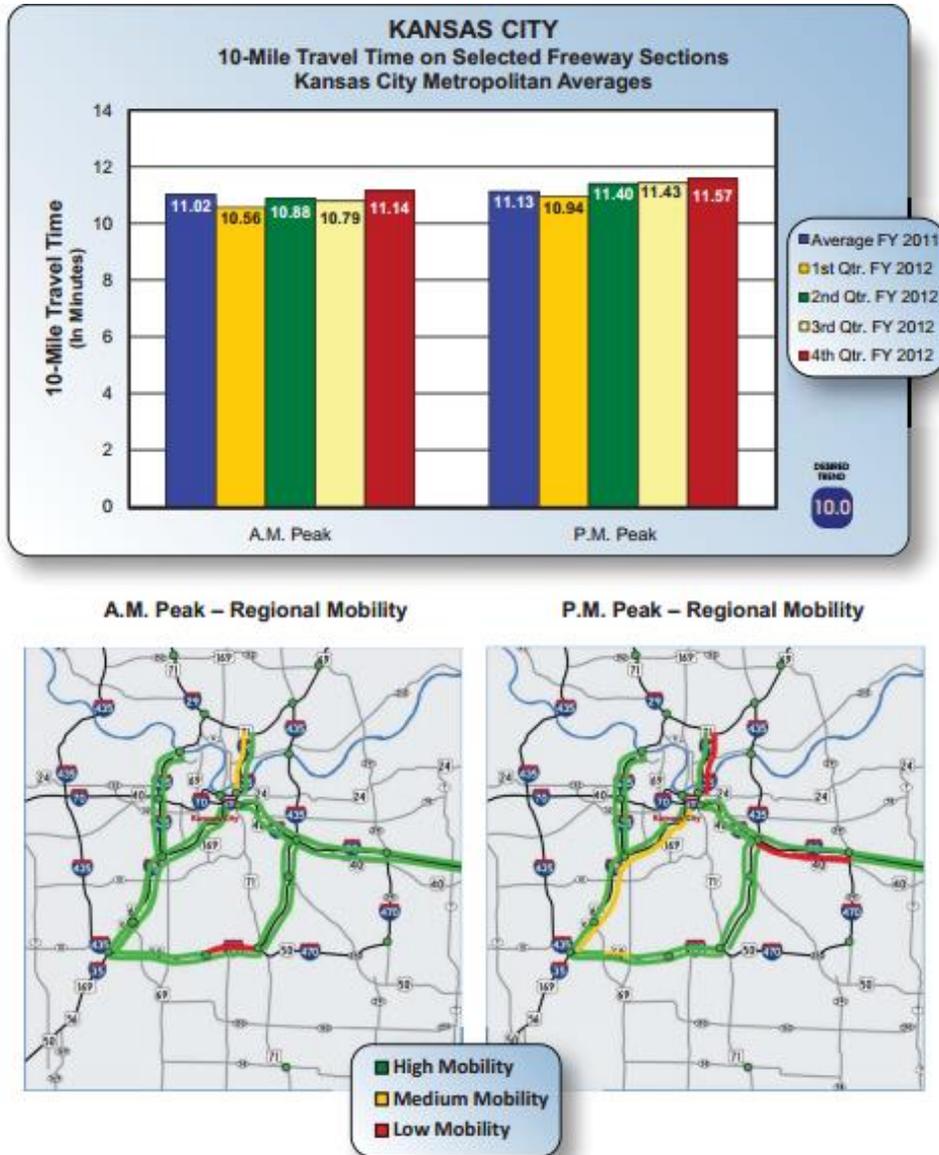


Figure 11: MoDOT graphics from Tracker July 2012

Sources

MoDOT Tracker July 2012 (Accessed: September 2012)  
<http://www.modot.org/about/Tracker.htm>

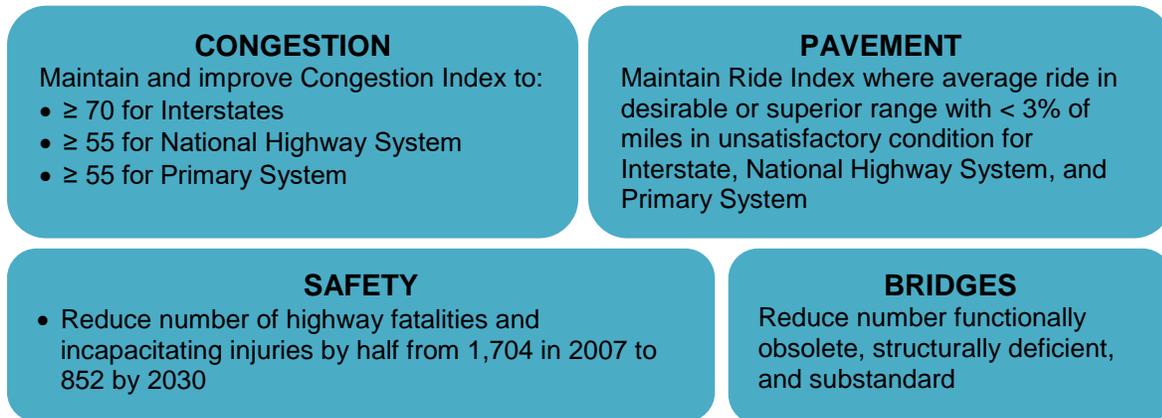
\* In addition to publicly available documents, this case study was augmented using information from an interview with MoDOT’s Organizational Performance Specialist (April 27, 2012)

‡ This case study has been reviewed by MoDOT’s Organizational Performance Specialist.

## 5. Montana

### 5.1 Measures Used and Current Framework

Montana DOT (MDT) organizes its performance measures by program area, with each program area having a broad performance objective or target, as shown below in Figure 12.



**Figure 12: MDT performance measures and associated program objectives/targets**

### 5.2 Measuring Progress toward Strategic Goals

The performance measures are not directly linked to the strategic goals. The MDT strategic plan is called TranPlan 21 and indicates several policy goals in seven categories:

#### **Economic Development**

- Preserve the efficient functioning of the transportation system used by export industries
- Support the tourism industry through promoting access to recreational, cultural, historical, and scenic destinations
- Develop MDT’s organizational capacity to support economic development
- Monitor and address capacity needs arising from state economic growth trends
- Support state and local economic development initiatives to maximize economic opportunities

#### **Traveler Safety**

- Provide leadership and coordinate with other Montana agencies to promote transportation system security
- Provide leadership and coordinate with other Montana agencies to improve traveler safety

- Reduce the number and severity of traffic crashes on Montana's roadways

**Access Management**

- Improve corridor level access management to preserve the highway system

**Land Use Planning**

- Provide technical support and leadership to encourage local jurisdictions to support transportation corridor preservation and management through their land use planning and development permitting authority
- Consistently apply MDT's System Impact Action Process to ensure developers equitably mitigate their impacts to the highway system

**Bicycle and Pedestrian Transportation**

- Target bicycle and pedestrian improvements to account for differences in current and future use
- Institutionalize bicycle and pedestrian modes

**Roadway System Performance**

- Establish explicit priorities for roadway improvements
- Preserve mobility for people and industry in Montana within available resources
- Improve the productivity of the roadway system

**Public Transportation**

- Work to improve service to social service passengers and the transportation disadvantaged through facilitating interagency funding consolidation
- Identify and implement transportation demand management actions that will work in Montana
- Preserve existing intercity public transportation service and encourage/facilitate the development of new services
- Promote and support increased use of public transportation systems

5.3 Using Performance Information in Decision Making

Investment analyses are performed on all proposed projects to determine their consistency with performance targets. The results are used when deciding which projects to implement and how much money is allocated.

MDT uses its Performance Programming Process (P<sup>3</sup>) to make decisions based on customer input, available resources, and system performance that will guide the

transportation system towards achieving its strategic goals. Figure 13 shows a flow chart describing the P<sup>3</sup>. The Funding Distribution Plan shown on the chart sets the level of funding that will be allocated to each district, system, and type of work. These allocations are based on predicted system performance given anticipated funding and a pre-determined program mix.

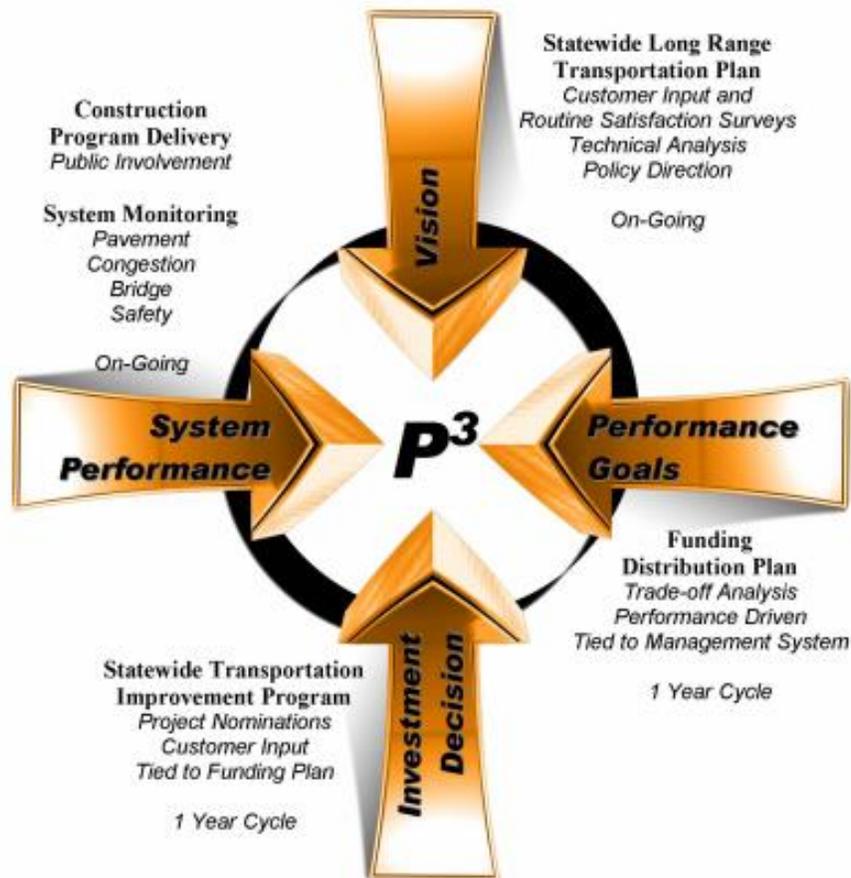


Figure 13: MDT's Performance Programming Process (adapted from MDT 2012)

MDT also uses a computer-based management system to summarize the condition of assets and evaluate impacts of investment options. The system tracks ride quality, rutting, delay time, traffic volume, pavement cracking, bridge condition, and crashes, among other measures. It is used to analyze various funding alternatives and also track the actual performance of the highway system.

5.4 Performance Management in the Organizational Structure and Processes

The P<sup>3</sup> system allows all employees to keep up with the department's goals and how their role in the organization fits into the bigger picture, as well as progress toward achieving

the goals and how that progress will be measured. This creates a high-level of organizational alignment (MDT 2004). MDT has eight programs—Transportation Planning, Aeronautics, Motor Carrier Services, Equipment, State Motor Pool, Maintenance, Construction, and General Operations—each with their own set of biennium goals and objectives. The General Operations program has five divisions under it: Administrative, Information Services, Human Resources, Internal Audit Unit, and Director’s Office (MDT 2011).

5.5 Reporting

No dedicated website was found for reporting performance externally; however, it was mentioned in the document that explains the P<sup>3</sup> system that the public and other stakeholders have the opportunity to comment on projects from the Transportation Implementation Plan annually. The appendix of the P<sup>3</sup> system document also contains some graphs depicting performance projections for its various measures. For example, Figure 14 shows the actual and projected pavement condition of the Interstate System.

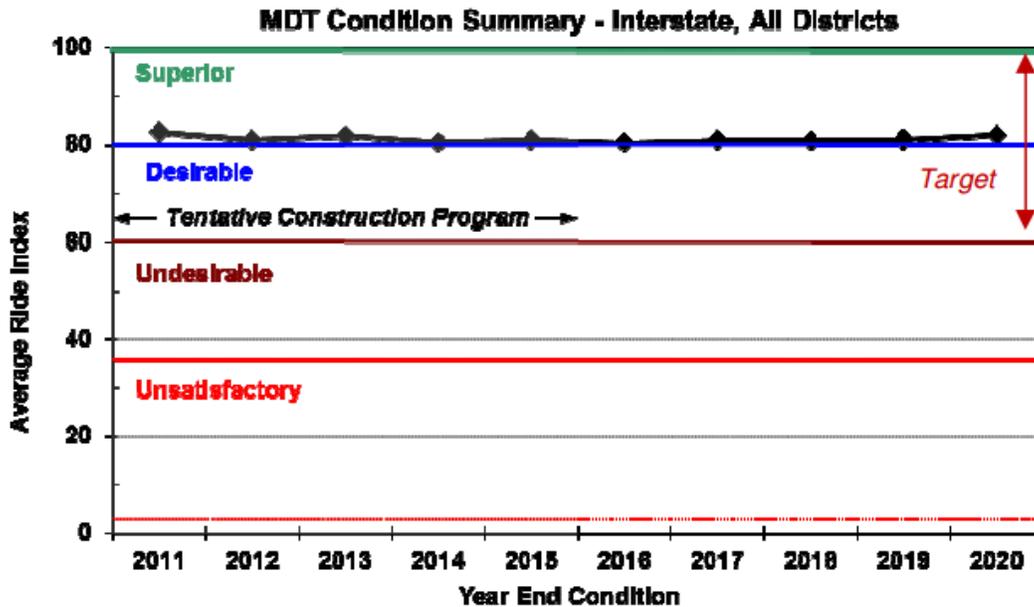


Figure 14: MDT Graphic Showing Actual and Projected Pavement Condition of Interstate System

Sources

- Performance Programming Process – A Tool for Making Transportation Investment Decisions (2012) <http://www.mdt.mt.gov/publications/docs/brochures/tranplanp3.pdf>
- Montana Traffic Records Strategic Plan (2011) [http://www.mdt.mt.gov/other/isd/external/trspi\\_trcc/nhtsa\\_408\\_grant/nhtsa\\_408\\_grant\\_information/2011\\_tr\\_strategic\\_plan\\_final.pdf](http://www.mdt.mt.gov/other/isd/external/trspi_trcc/nhtsa_408_grant/nhtsa_408_grant_information/2011_tr_strategic_plan_final.pdf)
- TranPlan 21 (2008) [http://www.mdt.mt.gov/pubinvolve/docs/tp21\\_brochure.pdf](http://www.mdt.mt.gov/pubinvolve/docs/tp21_brochure.pdf)

## 6. Texas<sup>‡</sup>

### 6.1 Measures Used and Current Framework

The online TxDOT Tracker performance reporting site indicates that the agency currently monitors nearly 70 performance measures. It has identified a “top ten” from the suite:

- Percentage of construction projects completed on time
- Percentage of construction projects completed on budget
- Percentage of design projects completed on time
- Percentage of design projects completed on budget
- Number of projects awarded
- Total expenditures reported in TxDOT's Operating Budget divided by the total appropriations included in the GAA
- Percent of contracts that included Historically Underutilized Businesses (HUBs)
- Number of fatalities
- Pavement condition
- Bridge condition

TxDOT came out with a new strategic plan that updated their performance measures and strategic goals in July 2012. The Tracker still appears to be referencing the previous set of measures and goals, which are similar except that the suite of measures is now more focused and concise. In both cases, all performance measures are organized by their associated strategic goals.

### 6.2 Measuring Progress toward Strategic Goals

TxDOT separates their measures into “outcome measures” and “output, efficiency, and explanatory measures”. Each measure is attributed to a goal and an objective. The output, efficiency, and explanatory measures are also tied to a “strategy” associated with each objective. The latest strategic goals and objectives are listed below along with their associated measures:

#### I. Outcome Measures

##### **Goal: Provide Transportation Planning**

###### *Objective: Effective Planning and Design*

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• Percentage of design projects completed on time</li> <li>• Percent of non-MPO funds allocated to improve the top 100 most congested roadway segments</li> </ul> | <ul style="list-style-type: none"> <li>• Percentage of design projects completed on budget</li> <li>• Percent of MPO funds allocated to improve the top 100 most congested roadway segments</li> </ul> |
|--|--|

##### **Goal: Implement Transportation Improvements**

###### *Objective: Construction and Reconstruction*

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• Percent of construction projects completed on budget</li> <li>• Percent two-lane highways with improved shoulders</li> </ul> | <ul style="list-style-type: none"> <li>• Percent of construction projects completed on time</li> <li>• Percent of general aviation pavement in good or excellent condition</li> </ul> |
|---|---|

**Goal: Preserve the Transportation System**

*Objective: System Maintenance*

- Statewide Maintenance Assessment Program (TxMAP) condition score
- Statewide Traffic Assessment Program (TxTAP) condition score
- Percent of bridges rated in good condition or higher

**Goal: Optimize Services and Systems**

*Objective 1: Support Enhanced Public Transportation*

- Percent change in the number of small urban and rural transit trips

*Objective 2: Enhance Public Safety and Security*

- Number of fatalities per 100 million miles traveled

**II. Strategies and Output, Efficiency, and Explanatory Measures**

**Goal: Provide Transportation Planning**

*Objective: Effective Planning and Design*

*Strategy: Plan, Design, and Manage Transportation Projects*

- Number of construction projects preliminary engineering plans completed for
- Number of projects awarded
- Dollar volume of construction contracts awarded in fiscal year
- Dollar volume of construction contracts awarded to improve the top 100 most congested roadway segments in fiscal year

**Goal: Implement Transportation Improvements**

*Objective: Construction and Reconstruction*

*Strategy: Support and Promote General Aviation*

- Number of grants approved for airports

**Goal: Preserve the Transportation System**

*Objective: System Maintenance*

*Strategy: New Maintenance Contracts*

- Number of lane miles contracted for resurfacing

*Strategy: Provide for State Transportation System Routine Maintenance/Operations*

- Number of highway lane miles resurfaced by State forces

**Goal: Enhance Rail Transportation**

*Objective: Enhance Rail Transportation*

*Strategy: Ensure Rail Safety through Inspection and Public Education*

- Number of Federal Railroad Administration (FRA) units inspected

### 6.3 Using Performance Information in Decision Making

The TxDOT Tracker has identified a subset of its performance measurement suite as Budgetary Performance Measures, which are formally included in the agency's biennial budgeting process (from FY2011):

- Number of airports selected for financial assistance
- Number of construction project engineering plan sets completed
- Dollar volume of pass-through toll financing agreements executed during each fiscal year
- Federal Railroad Administration (FRA) units
- Number of oversize/overweight permits issued
- Project to funding ratio
- Vehicle miles traveled
- Dollar volume of construction projects awarded in a fiscal year

### 6.4 Performance Management in the Organizational Structure and Processes

The Office of Operational Excellence (OPE) supports TxDOT's Executive Administration and the Texas Transportation Commission in developing a strategic direction for the future of transportation in Texas. OPE also works with TxDOT regions, divisions, districts and offices to draft objectives, strategies and performance measures to support the strategic direction statements and to actively gauge how the agency is performing. OPE reports to the Chief Strategy and Administration Officer at TxDOT and works closely with the Office of State and Legislative Affairs when working on TxDOT's objectives, strategies and performance measures.

### 6.5 Reporting

The TxDOT Tracker is an online dashboard that reports all of the performance measurements collected by the agency. Tracker data is updated on a semi-annual basis, and the most current results are from FY 2011—before implementation of the new strategic goals and performance measurement suite. Targets are shown along with a “traffic signal” image displaying green for “will attain target”, yellow for “may not attain target”, and red for “will not attain target”. The actual measurements are also shown. Many of the measures have brief additional comments to further clarify the results. Figure 15 shows a few example entries from Tracker. By clicking on any measure, more information can be viewed such as the purpose of each measure, the data source and methodology used in obtaining it, an analysis of the meaning of the results and plans to respond, and a brief forecast for the next fiscal year. Graphical time series charts are also available here, showing years 2005-2010 and the average of the latest measurements.

In 2010 TxDOT also released a detailed performance report that summarizes the same information found in the Tracker for FY 2010 and offers additional discussion about the meaning of the results and plans to respond.

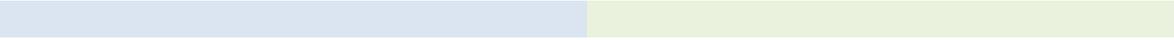
Performance Measure		Current Reporting Period	Semi-Annual Progress	Target FY 2011	Comments
Construction	<a href="#">On Time</a>	57%	Green	75%	Based on the current performance trends, it appears that the department is making progress toward the target of 75% of projects completed on time for FY 2011.
	<a href="#">On Budget</a>	88%	Green	90%	Based on the current performance trends, it appears that the department will approach the target of 90% of projects completed on budget for FY 2011.
Design	<a href="#">On Time</a>	59%	Yellow	90%	Based on analysis of the first six months of design projects completed on time, it is unlikely that the department will attain its goal of 90% for FY 2011.
	<a href="#">On Budget</a>	47%	Green	50%	The mid year FY 2011 design on budget results are a 15% improvement from the FY 2010 design on budget results of 41%, and a 67% progress toward the 50% goal.
<a href="#">Dollar Volume of Contracts Awarded in a Fiscal Year</a>		22.69%	Red	100%	Unless additional funds become available or cash flows improve it is anticipated that the department may only be able to meet 50 to 60 percent of the targeted amount.

Figure 15: Screen shot of TxDOT's Tracker

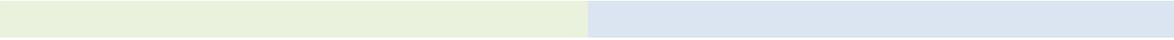
Sources

- TxDOT Strategic Plan 2013-2017 (2012) [http://ftp.dot.state.tx.us/pub/txdot-info/oeo/strategic\\_plan2013.pdf](http://ftp.dot.state.tx.us/pub/txdot-info/oeo/strategic_plan2013.pdf)
- TxDOT Performance Results (2010) [ftp://ftp.dot.state.tx.us/pub/txdot-info/sppm/txdot\\_results.pdf](ftp://ftp.dot.state.tx.us/pub/txdot-info/sppm/txdot_results.pdf)
- TxDOT Tracker (2011) Accessed: September 2012. [http://apps.dot.state.tx.us/txdot\\_tracker/](http://apps.dot.state.tx.us/txdot_tracker/)

‡ This case study has been reviewed by a Strategy & Administration Analyst in TXDOT's Office of Operational Excellence



## **IV. Eastern States**



## 7. Connecticut

### 7.1 Measures Used and Current Framework

Connecticut DOT originally organized its performance measures based on the five strategic goals from the long range plan. In 2011 however, the measures were reorganized. The measures remain linked to strategic objectives, but because many measures relate to multiple objectives, they are now categorized in four modes and an additional “administration” category, with subcategories such as fleet, safety, passenger and pavements. This organization is very recent and only the reports from 2011 follow this framework so far. Past reports maintain the framework based on the five strategic goals. Figure 16 lists each category and its related measures.

<p style="text-align: center;"><b>Highways</b></p> <ul style="list-style-type: none"> <li>• Highway fatalities</li> <li>• Seat Belt Usage</li> <li>• Highway Ride Quality</li> <li>• Highway Bridge Condition</li> <li>• Highway Bridge Maintenance</li> <li>• Bicycle/Pedestrian Access</li> <li>• Highway Capacity</li> <li>• CHAMP Motorist Assists</li> </ul>	<p style="text-align: center;"><b>Airport</b></p> <ul style="list-style-type: none"> <li>• Airport Pavement Condition</li> <li>• Bradley International Airport Passengers</li> <li>• Bradley International Parking</li> </ul>
<p style="text-align: center;"><b>Bus</b></p> <ul style="list-style-type: none"> <li>• Miles between Road Calls</li> <li>• Age of Bus Fleet</li> <li>• CTTransit Passenger Trips</li> </ul>	<p style="text-align: center;"><b>Administration</b></p> <ul style="list-style-type: none"> <li>• Construction Contracts Awarded within 60 Days of Bid Opening</li> <li>• Construction Contracts Completed within Budget</li> <li>• Construction Contracts Completed on Time</li> <li>• Project Closeouts</li> <li>• CT Recovery Projects Completed On-Time</li> <li>• CT Recovery Dollars Expended</li> <li>• CT Recover Jobs Created/Sustained</li> </ul>
<p style="text-align: center;"><b>Rail</b></p> <ul style="list-style-type: none"> <li>• Rail Fleet Reliability</li> <li>• Rail On-Time Performance</li> <li>• Rail Passenger Trips</li> </ul>	

**Figure 16: CTDOT performance measures organized by modal and administration categories**

Figure 17 shows sample entries from a 2011 quarterly performance report from the Highway category. As shown in Figure 17, each measure is associated with a performance target, and current measurement values are compared with historical trends.

### 7.2 Measuring Progress toward Strategic Goals

CTDOT’s long range plan identifies five Strategic Goals:

- Safety & Security
- Preservation
- Efficiency & Effectiveness
- Quality of Life
- Accountability & Transparency.

Prior to 2011, performance measures were directly linked to these goals. The measures are now linked to the following eight policy objectives, which are linked to the CTDOT's core mission:

- Provide Safe and Secure Travel
- Reduce Congestion and Maximize Throughput
- Preserve and Maintain our Transportation Infrastructure
- Provide Mobility Choice, Connectivity and Accessibility
- Improve Efficiency and Reliability
- Preserve and Protect the Environment
- Support Economic Growth
- Strive for Organizational Excellence

Each performance measure may be linked to more than one policy objective. **Error! Reference source not found.** shows a sample entry from a 2011 quarterly performance report, which includes a sidebar indicating which strategic objective(s) each performance measure is associated with.

### 7.3 Using Performance Information in Decision Making

As discussed on CTDOT's performance measurement website, "[t]he Connecticut Department of Transportation is committed to full transparency in its business of preserving, managing and developing the State's transportation system." To help ensure such transparency, "[m]easures are continually reviewed... to determine their usefulness in helping the Department make strategic decisions for managing infrastructure assets." The CTDOT long range plan also alludes to performance measures being incorporated into funding decisions; however, publicly available documents do not demonstrate this explicitly. Although the quarterly performance report and year-end summaries provide a "discussion of the trend" for each performance measure, which describes reasons and challenges for the trend in a matter-of-fact way, these discussions do not suggest actions that the agency can or will take in order to affect performance trends.

### 7.4 Performance Management in the Organizational Structure and Processes

As illustrated in Figure 18, each performance measure has its "source" in a particular bureau within the agency. The new organization of measures supports this kind of "sourcing" since the agency's bureaus are segregated according to mode or function (for example, Bureau of Highway Operations, Bureau of Public Transit, Bureau of Finance and Administration). The source information from each Bureau is compiled by CTDOT's Division of Policy and Performance Measures (within the Office of Strategic Planning and Projects). The Division has a three-fold purpose: It "[1] prepares and posts the Department's quarterly performance measures... [2] is also responsible for developing and implementing Transportation Asset Management principles, practices and policies to effectively and efficiently maintain, preserve, manage and upgrade Connecticut's transportation infrastructure... [and 3] develops Department-wide policies, principles and best practice methods for improving resource allocation and utilization decisions, and is responsible for the Long Range Transportation Plan for the State."

**CTDOT PERFORMANCE MEASURES**  
 2011 Quarter 4 (October 1 to December 31)

[Click Here to Go to 2011 Summary Page](#)

**LEGEND**

**Performance**

- Performance Is Improving
- Performance Remains Similar
- Performance Is Declining

Updated this Quarter (y/m)	Sheet No.	Sheet Name	Performance Measure(s)	Target	Comparative Reporting Period	Latest Reporting Period	Performance	Target Met or On-Track
<b>HIGHWAYS</b>								
<b>Safety</b>								
y	PM-01	Highway Fatalities	Rate of Annual Highway Fatalities per 100 million vehicle miles traveled (VMT), CTDOT	0	0.71 (CY-2009)	1.02 (CY2010)		
			Rate of Annual Highway Fatalities per 100,000 population	0	6.34 (CY-2009)	8.92 (CY2010)		
n	PM-02	Seat Belt Usage	Percent of Seat Belt Usage	90%	88% (CY-2010)	88% (CY2011)		
<b>Pavements</b>								
n	PM-03	Highway Ride Quality	Percent of NHS Roads with Good Ride Quality	Increase %	44% (CY-2009)	49% (CY2010)		✓
			Percent of Entire Network with Good Ride Quality	Increase %	20% (CY-2009)	20% (CY2010)		
<b>Bridges</b>								
n	PM-04	Highway Bridge Condition	Percent of CTDOT Roadway Bridges in Good Condition	Increase %	34% (CY2009)	32% (CY2010)		

Figure 17: A factsheet-style table of contents summarizes CTDOT’s performance results for the 2011 Quarter 3 report, in which performance measures are organized by modal and administrative functional areas.

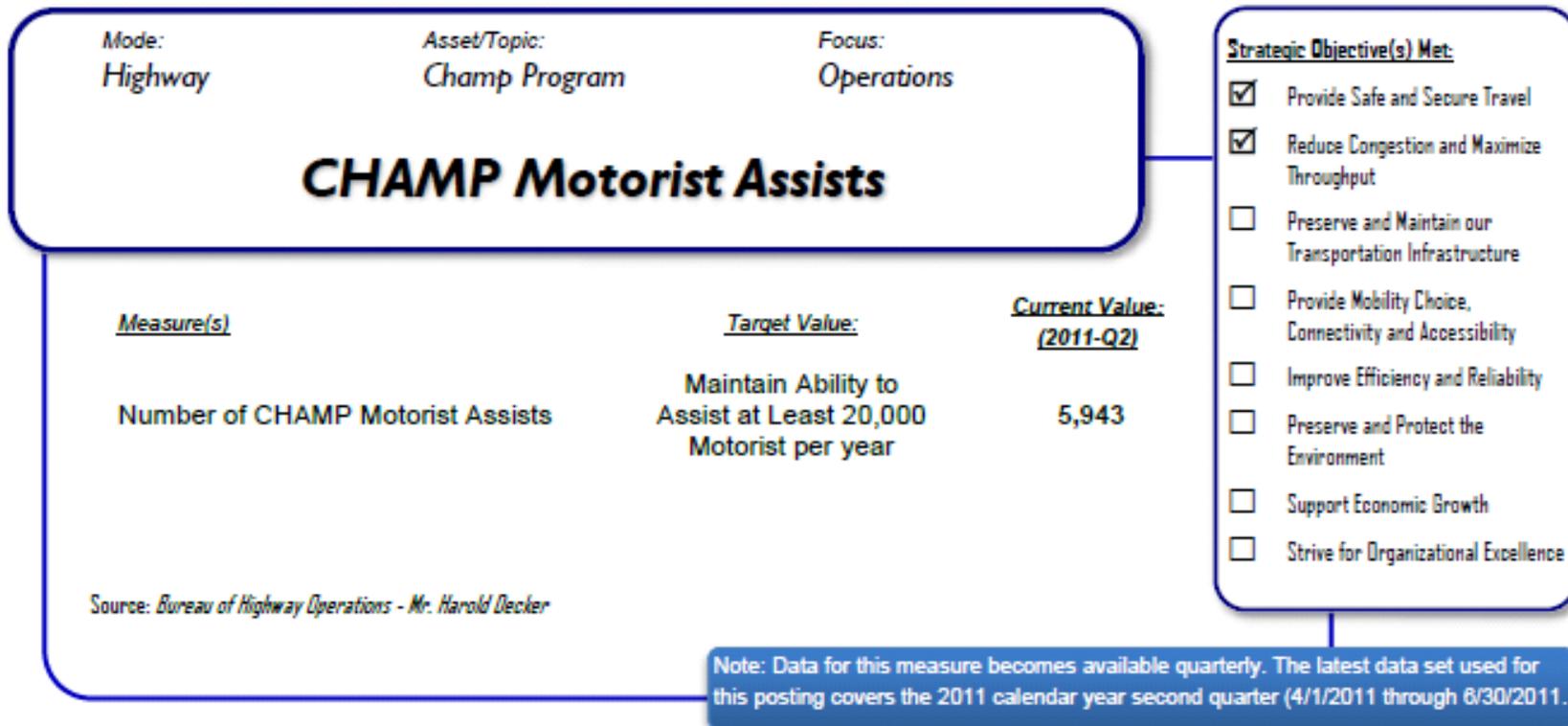


Figure 18: Entry in CTDOT’s quarterly performance report introducing the CHAMP Motorist Assists measure, which supports the Provide Safe and Secure Travel and Reduce Congestion and Maximize Throughput objectives.

7.5 Reporting

Customer service is a value for CTDOT and as such external reporting is a priority. Transparency is a goal and the quarterly performance measures reports are available to the public online, beginning in 2009 (the first year the reports were generated). These reports are also available to internal stakeholders.

Figures 17, 18, and 19 provide screenshots from CTDOT’s quarterly performance report, which provides visually appealing and easily understood graphics. In the reports, each measure is categorized by mode, asset or topic, and a focus (condition, operations, utilization, etc.). Each measure has its own detailed entry, which includes its purpose and description, and a discussion of trends over time.

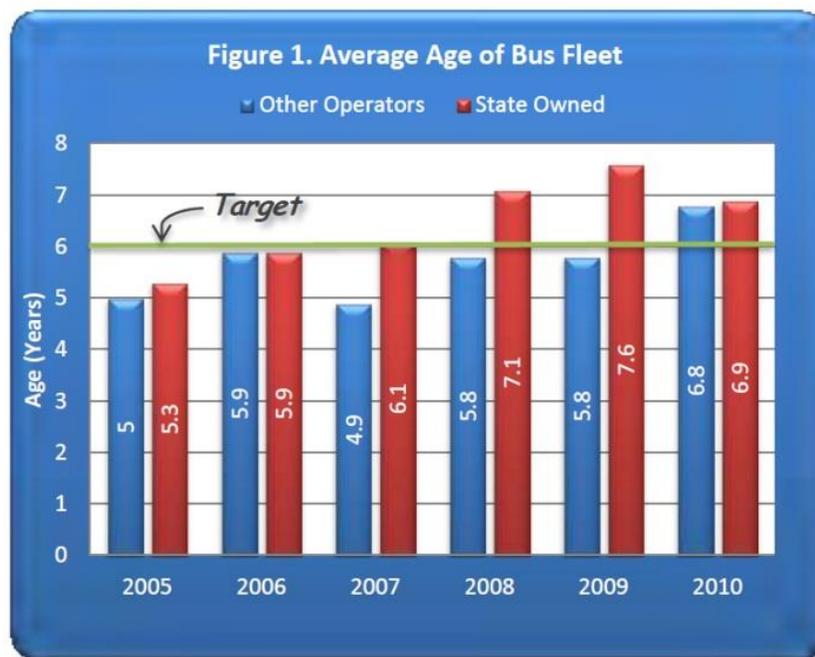


Figure 19: Entry in CTDOT’s quarterly performance report showing the annual trend of the Average Age of Bus Fleet performance measure.

Sources (Accessed 2012)

- CTDOT Strategic Plan:  
[http://www.ct.gov/dot/lib/dot/documents/dpolicy/lrp/2009lrp/lrp2009\\_final\\_document\\_june\\_2009.pdf](http://www.ct.gov/dot/lib/dot/documents/dpolicy/lrp/2009lrp/lrp2009_final_document_june_2009.pdf)
- CTDOT *On the Move* – Performance Measures website:  
<http://www.ct.gov/dot/cwp/view.asp?a=3815&q=448402> provides an overview of the agency’s commitment to transparency and performance monitoring, and provides links to quarterly performance reports from 2008 through 2011.
- Office of Strategic Planning and Programs description:  
<http://www.ct.gov/dot/cwp/view.asp?a=3529&q=464076>

## 8. Florida

### 8.1 Measures Used and Current Framework

Florida Department of Transportation (FDOT) develops performance measures according to a hierarchical framework, illustrated in Figure 20. The agency’s suite of approximately 20 measures include more outcome-oriented measures developed at the policy-level, more output-oriented measures at the project level, with a mixture of output and outcome measures at the system- and program-levels.

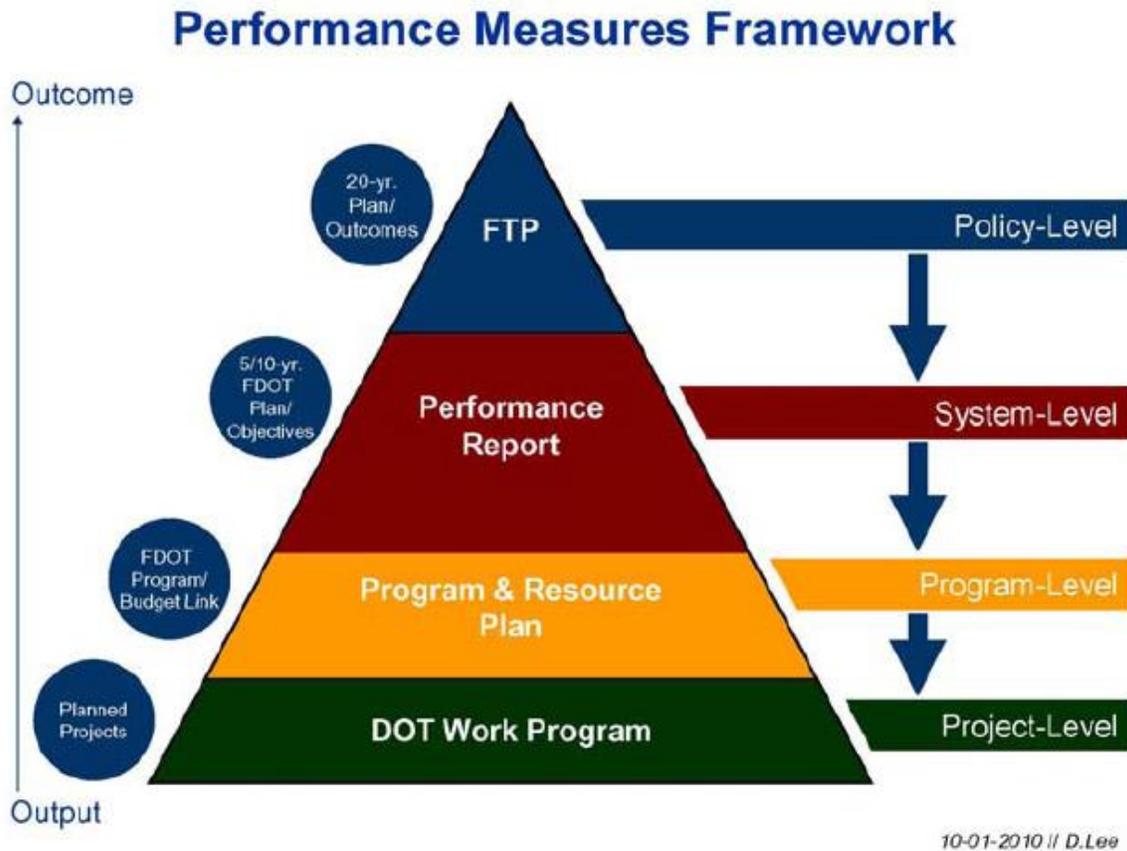


Figure 20: Florida DOT’s performance measurement framework

The Department establishes goals in the long-range transportation plan and develops desired outcomes at the policy level. At the system level, quantifiable objectives are determined in the short-range plan to meet the goals. A Program and Resource Plan links the goals and objectives to the agency’s budgeting process through target setting and resource allocation. At the project level, a financially constrained five-year program of projects is developed. The performance measures are available for all levels and provide both small details and big picture results.

The 2011 FDOT Performance Report establishes the objectives and measures associated with each strategic goal. The four goals are:

- Safety and Security
- Maintenance and Operations
- Economic Competitiveness and Mobility
- Quality of Life and Environmental Stewardship

In addition to the agency-wide key performance measures, each of FDOT's offices and programs has developed performance measures that are specific to its particular function.

## 8.2 Measuring Progress toward Strategic Goals

FDOT has four goals, each with a number of objectives that suggest performance measures and a set of strategies for achievement. The goal and objectives are as follows:

- 1. Provide a safe and secure transportation system for all users**
  - Reduce by 5 percent annually, the highway fatality and serious injury rate per 100 million vehicle miles traveled
  - Update emergency response plans and readiness procedures for disaster response and conduct regular training exercises
- 2. Maintain and operate Florida's transportation system proactively**
  - Ensure that 80 percent of pavement on the State Highway System meets Department standards
  - Ensure that 90 percent of Department-maintained bridges meet standards while keeping all Department-maintained bridges open to the public safe
  - Achieve 100 percent of the acceptable maintenance standard on the State Highway System
  - Improve system efficiency by deploying Intelligent Transportation Systems (ITS) technology on critical state corridors
- 3. Invest in transportation systems to support a prosperous, globally competitive economy – Improve mobility and connectivity for people and freight**
  - Make strategic investments that support statewide and inter-regional mobility
  - Allocate up to 75 percent of new discretionary capacity funds to the Strategic Intermodal System
  - Maintain the average growth rate in person-hours of delay on Florida Strategic Intermodal System highways at or below 5 percent
  - Support efforts to enable Florida to expand its role as a hub for international and domestic trade
  - Maximize the use of existing facilities
  - Develop/redevelop multi-modal corridors to support future mobility
  - Participate in statewide and regional visioning efforts

- Increase transit ridership at twice the average rate of population growth
- 4. Make transportation decisions to support and enhance livable communities – Make transportation decisions to promote responsible environmental stewardship**
- Make transportation decisions in the context of community interests, plans, values and visions
  - Enhance the Florida travel experience
  - Deliver a transportation system that supports quality of life and environmental stewardship

Other performance measurement processes also support the long-range goals, including an annual customer service survey and mobility performance measures.

8.3 Using Performance Information in Decision Making

FDOT explicitly links project programming to planning decisions. This is primarily done through the Program and Resource Plan. Performance is also linked to planning decisions and goals. Performance is measured in the Annual Performance Report that evaluates the Departments short-range objectives and long-range goals. The performance management cycle was recently changed to reflect the linkage of performance measurement to each step in the planning process (Figure 21).



**Figure 21: Performance management cycle at FDOT**

FDOT uses performance information in decision making during project selection through an Efficient Transportation Decision Making (ETDM) process. ETDM incorporates “early collaboration with regulatory agencies, other stakeholders and the public [to identify] potential environmental and sociocultural effects” of projects. It also uses a web-based Environmental Screening Tool (EST), which integrates data from more than multiple sources into a GIS platform.

8.4 Performance Management in the Organizational Structure and Processes

FDOT has a Performance Management and Training Office, which reports to the Assistant Secretary for Intermodal Systems Development and the Florida Transportation Commission (FTC). The FTC is an outside entity and an oversight board that reviews the long-range plan and performance and budget requests, monitors financial status, and produces the annual “Performance and Production Review.” This has positive implications for horizontal collaboration because the Performance Management and Training office manages performance measurement across the entire agency. Under their management, performance reporting occurs for the most part in the planning offices. Data for tracking performance is obtained from various offices and departments in FDOT, including the Office of Transportation Statistics and the Department of Motor Vehicles. The Office of Policy Planning also produces the long-range Florida Transportation Plan, which identifies goals, objectives and strategies that influence performance measurement. As shown in Figure 21, financial policies and project delivery also influence performance measurement. Therefore, the effectiveness of performance management will depend on the effectiveness of coordination and communication among the offices presiding over these other functions.

### 8.5 Reporting

All performance measures used by FDOT’s offices and programs are available for viewing on a shared internal database called the PBViews Performance Management System. FDOT started using PBViews in 2002. At first, the system only reported “key performance measures,” but over time it has been expanded to include measures used at every level.

Performance results are available to the public through the Annual Performance Report, the Florida Transportation Indicators Website, and the Trends and Conditions report. Additional performance results can be found in the Performance and Production Review, published online by the Florida Transportation Commission. The ETDM also has a public website that allows the public to find information about potential projects and to provide feedback.

### Sources

- Description of ETDM on the FDOT website:  
<http://www.dot.state.fl.us/emo/ETDM.shtm>
- Public ETDM Website : <https://etdmpub.fl.a-etat.org/est/>
- Transportation Performance Reporting in Florida website:  
<http://www.dot.state.fl.us/planning/performance/>
- Florida Transportation Plan 2025:  
<http://www.dot.state.fl.us/planning/FTP/2025FTP-LowRes.pdf>

## 9. Maryland\*‡

### 9.1 Measuring Progress toward Strategic Goals

The Maryland Department of Transportation performance measures are organized in a goals-based framework. The Maryland Transportation Plan (MTP) (a long-range plan with a 20-year planning horizon) contains 5 strategic goals, progress toward each of which is tracked using several “outcome oriented” performance measures, as listed in Figure 22.

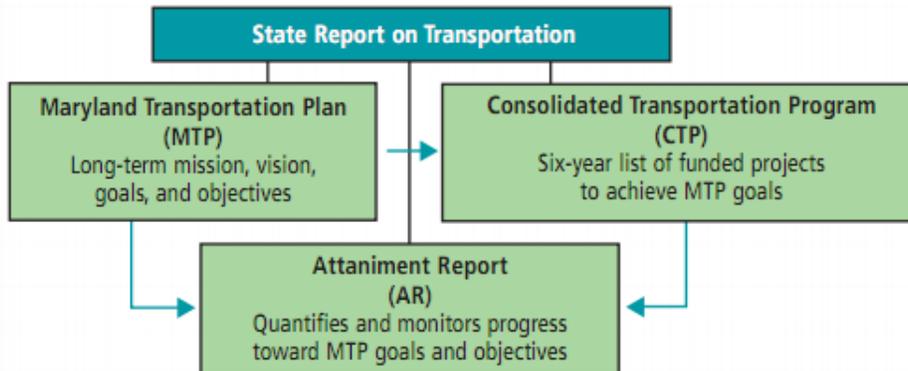
<b>Connectivity for Daily Life</b>	
<ul style="list-style-type: none"> <li>• Number of nonstop airline markets served</li> <li>• International cruises using the Port of Baltimore</li> <li>• Port of Baltimore foreign cargo and MPA general cargo tonnage</li> <li>• Annual revenue vehicle miles of service provided</li> <li>• Average weekday transit ridership</li> <li>• Percent of information system availability compared to total number of records maintained</li> <li>• Percentage of state-owned roadway directional miles within urban areas that have sidewalks and percent of sidewalks that meet Americans with Disabilities Act (ADA) compliance</li> <li>• Percentage of state-owned roadway directional miles with a bicycle level of comfort (BLOC) grade “D” or better and mileage of SHA-owned highways with marked bike lanes</li> <li>• Percent of freeway lane-miles and arterial lane-miles with average annual volumes at or above congested levels</li> </ul>	
<p style="text-align: center;"><b>Quality of Service</b></p> <ul style="list-style-type: none"> <li>• Percent of BWI Marshall customers rating the airport “good” or “excellent” on key services</li> <li>• Average truck turn-around time at Seagirt Marine Terminal</li> <li>• Percent of service provided on time</li> <li>• Customer satisfaction rating</li> <li>• Overall customer satisfaction of E-ZPass® customers</li> <li>• Percent of toll transactions collected electronically</li> <li>• Branch office customer visit time versus customer satisfaction rating</li> <li>• Maryland driver satisfaction rating</li> <li>• Percentage of the Maryland SHA network in overall preferred maintenance condition</li> </ul>	<p style="text-align: center;"><b>Environmental Stewardship</b></p> <ul style="list-style-type: none"> <li>• Transportation-related emissions by region</li> <li>• Transportation-related greenhouse gas emissions</li> <li>• Transportation Emission Reduction Measures (TERMs)</li> <li>• Acres of wetlands or wildlife habitat created, restored, or improved since 2000</li> <li>• Compliance rate and number of vehicles tested for Vehicle Emissions Inspection Program (VEIP) versus customer wait time</li> <li>• Acres of wetlands restored and miles of streams restored</li> <li>• Total fuel usage of the light fleet</li> <li>• Travel Demand Management</li> </ul>

System Preservation & Performance	Safety & Security
<ul style="list-style-type: none"> <li>• Airline cost per enplaned passenger (CPE)</li> <li>• Non-airline revenue per enplaned passenger (RPE)</li> <li>• Adequate dredge material placement capacity remaining for Harbor and Bay maintenance and new work dredging</li> <li>• Revenue versus operating expense</li> <li>• Operating cost per passenger trip</li> <li>• Operating cost per revenue vehicle mile</li> <li>• Passengers per revenue vehicle mile</li> <li>• Cost per transaction</li> <li>• Alternative service delivery transactions as percent of total transactions</li> <li>• User cost savings for the traveling public due to incident management</li> <li>• Percent of roadway miles with acceptable ride quality</li> <li>• Number of bridges and percent that are structurally deficient</li> </ul>	<ul style="list-style-type: none"> <li>• BWI Marshall crime rate</li> <li>• Number of repeat discrepancies in the annual Federal Aviation Administration’s Federal Aviation Regulation inspection</li> <li>• Rate of airfield ramp incidents and accidents per 1,000 operations</li> <li>• MPA compliance with the Maritime Transportation Security Act of 2002</li> <li>• Customer perceptions of safety on the MTA system</li> <li>• Preventable accidents per 100,000 vehicle miles</li> <li>• Percent of Homeland Security REAL ID Act benchmarks achieved</li> <li>• Number of bicycle and pedestrian fatalities and injuries on all Maryland roads</li> <li>• Annual number of traffic fatalities and personal injuries on all roads in Maryland</li> </ul>

**Figure 22: MDOT Performance Measures organized by strategic goal**

9.2 Using Performance Information in Decision Making

The Maryland Transportation Plan (MTP) seeks to guide statewide investments and identify approaches to achieve MDOT’s goals and objectives. An advisory group of external stakeholders as well as management from each modal agency is convened for the development of the MTP. As shown in Figure 23, the MTP informs the six-year program of projects. Both the MTP and the program of projects are monitored by the annual Attainment Report.



**Figure 23: Flow chart of MDOT’s decision making and reporting process**

The annual Attainment Report identifies “Key Initiatives” associated with advancing progress toward each strategic goal. It also suggests reasons why performance changed from one reporting period to the next, highlights actions taken by the agency, and identifies future performance strategies.

### 9.3 Performance Management in the Organizational Structure and Processes

MDOT oversees five transportation agencies (which oversee aviation, ports, transit, motor vehicles, and highways), and MDOT’s Secretary chairs the state’s tolling authority. Each of these agencies is responsible for performance monitoring in its area of expertise. For certain performance measures where horizontal integration and collaboration are deemed necessary, multiple “monitoring agencies” are identified for the measure. For example, the “Annual number of traffic fatalities and personal injuries on all roads in Maryland” is jointly monitored by the State Highway Administration, the Maryland Transportation Authority, and the Motor Vehicle Administration. Performance measurement is housed in each modal agency and coordinated centrally through performance management staff at MDOT. The results are published by MDOT in the Attainment Report.

### 9.4 Reporting

Performance measurement results are compiled in the annual Attainment Report. This report is available for the public online. MDOT performance is also integrated into the Governor’s state-wide reporting program, StateStat. StateStat is a data-based management program that enables the State to monitor numerous performance indicators on a regular (monthly) basis, identify trends, advance coordination, and develop strategies to improve performance. The information is available to the public, with data, trends, and GIS-based maps available in detailed reports on the StateStat website.

### Sources

- Maryland Transportation Plan 2009 : [http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/Plans\\_Programs\\_Reports/Reports/MTP/09MTP.pdf](http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/Plans_Programs_Reports/Reports/MTP/09MTP.pdf)
- Maryland Annual Attainment Report 2012: [http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/CTP/CTP\\_12\\_17/Final\\_CTP/2012\\_Attainment\\_Report.pdf](http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/CTP/CTP_12_17/Final_CTP/2012_Attainment_Report.pdf)
- Maryland StateStat website : <http://www.statestat.maryland.gov/>

\* In addition to publicly available documents, this case study was augmented using information from an interview with MDOT’s Manager of Performance and Strategic Planning (May 8, 2012).

‡ This case study has been reviewed by MDOT’s director of the Office of Planning and Preliminary Engineering.

## 10. Virginia\*\*‡

### 10.1 Measures Used and Current Framework

VDOT's long range plan lists several measures associated with each of its seven strategic goals, as shown in Figure 24. However, only six measures are listed as "Governor's key performance measures," which are reported on the commonwealth of Virginia's inter-agency performance website "Virginia Performs." These six measures, are categorized in four areas as follows:

- Safety
  - Number of roadway crash related deaths per year
- Congestion
  - Percent of congestion free travel on all interstate roadways
  - Annual hours of delay (segmented by region)
- Management
  - On-time and On-Budget roadway project delivery
- Productivity
  - Construction Engineering and Inspection Expense
  - VDOT Administrative Expense

### 10.2 Measuring Progress toward Strategic Goals

The *Governor's Multimodal Strategic Plan for the Commonwealth of Virginia* (2010) identified eight goals to guide unified transportation policymaking across governmental agencies. VDOT has developed objectives and action plans for each of these goals in the VDOT Business Plan. These goals are aligned with the long-range transportation plan, VTrans2035, which highlights seven goals.

<p><b>Safety and Security</b></p> <ul style="list-style-type: none"> <li>• Highway Fatalities and Fatality Rate</li> <li>• Highway Crashes and Crash Rate</li> <li>• Transit Crashes</li> <li>• Aviation Crashes</li> <li>• Compliance with Maritime Transportation Security Act</li> <li>• Airports Participating in Voluntary Security Certification Plan</li> <li>• Updated Safety and Security Plans</li> </ul>	<p><b>Program Delivery</b></p> <ul style="list-style-type: none"> <li>• VDOT Projects Completed On-Time and On-Budget</li> <li>• Operating Cost Per Transit Trip</li> <li>• VDOT Admin/Total Expenditures</li> <li>• DMV Service Centers – Wait Time</li> <li>• VDOT Customer Satisfaction</li> </ul>
<p><b>Economic Vitality</b></p> <ul style="list-style-type: none"> <li>• Gross State Product - Transportation</li> <li>• Port of VA East Coast Market Share</li> <li>• Transportation Sector Employment</li> <li>• Freight Through the Port of Virginia</li> <li>• Number of Enplanements</li> <li>• Discretionary Expenditures with Small, Women, and Minority-owned (SWaM) Businesses</li> </ul>	<p><b>Mobility, Accessibility and Connectivity</b></p> <ul style="list-style-type: none"> <li>• Transit Trips Per Capita</li> <li>• Transit Revenue Miles</li> <li>• HOV Use Northern VA</li> <li>• HOV Use Hampton Roads</li> <li>• Hours of Delay Northern VA</li> <li>• Hours of Delay Hampton Roads</li> <li>• Hours of Delay Richmond</li> <li>• Park and Ride Spaces</li> <li>• Bicycle Travel</li> <li>• Pedestrian Travel</li> <li>• Intercity Rail Service</li> <li>• Freight Moved by Rail or Barge</li> </ul>
<p><b>Environmental Stewardship</b></p> <ul style="list-style-type: none"> <li>• Mobile Source Emissions</li> <li>• Greenhouse Gas Emissions</li> <li>• Fuel Usage Per Capita</li> <li>• Acres of Wetland Replaced</li> </ul>	<p><b>Transportation and Land Use</b></p> <ul style="list-style-type: none"> <li>• VMT Per Capita – Northern VA</li> <li>• VMT Per Capita – Hampton Roads</li> <li>• VMT Per Capita – Richmond</li> <li>• VMT Per Capita - Statewide</li> <li>• Population Density – Northern VA</li> <li>• Population Density – Hampton Roads</li> <li>• Population Density – Richmond</li> <li>• Jobs/Housing Ratio – Northern VA</li> <li>• Jobs/Housing Ratio – Hampton Roads</li> <li>• Jobs/Housing Ratio – Richmond</li> <li>• Teleworking</li> </ul>
<p><b>Maintenance and Preservation</b></p> <ul style="list-style-type: none"> <li>• Interstate Pavement Condition</li> <li>• Primary Pavement Condition</li> <li>• Secondary Pavement Condition</li> <li>• Bridge Condition</li> <li>• Average Transit Vehicle Age</li> </ul>	

**Figure 24: Virginia’s transportation performance measures, organized by strategic goals from the long-range plan (VTrans2035).**

10.3 Using Performance Information in Decision Making

Over the last 10 years there have been research efforts through the Virginia Center for Transportation Innovation and Research (VCTIR) to evaluate safety, congestion and pavement conditions. Reports from the VCTIR on these issues outline the development of performance measures intended to be used to prioritize future transportation improvements and investments.

The current suite of performance measures is used to track performance. Each measure has an associated target. The targets are evaluated annually at a minimum and the performance trends for these measures receive high level reviews.

The Virginia Performs website identifies the general trends of performance in three categories. It also points out that the State has significant influence in infrastructure condition and traffic congestion, but limited influence in land use trends (Figure 25).



**Figure 25: Transportation Indicators at a glance on Virginia Performs Website**

10.4 Performance Management in the Organizational Structure and Processes

In VDOT, under the Commissioner of Highways, performance is monitored by Safety and Performance Management. VDOT reports performance through its online Dashboard and the Quarterly Report Card. It also submits performance results to the Department of Planning and Budget through Virginia Performs, an online system that shows every agency’s strategic plan. Performance is linked to the budget through the Service Area Plan, which is also available via Virginia Performs.

10.5 Reporting

Performance is reported via the VDOT dashboard online. The dashboard provides overall and detailed performance information in seven categories, as follows:

- Highway Performance
- Safety
- Condition
- Finance
- Project Delivery
- Citizen Survey

- Management

The VDOT dashboard allows users to view system-wide as well as corridor-level and/or district level performance information for most of its measures. It is updated at least quarterly by each department and more frequently by the departments that continually collect performance information (i.e. Engineering). VDOT has suggested that the dashboard has improved interdepartmental communication and that performance has improved through transparent reporting.

Transportation performance information can also be found on the Virginia Performs website, where it is presented alongside performance information from other state agencies. Additionally, performance reports are provided to the general assembly annually.

**Sources**

- Office of Intermodal Planning and Investment website:  
[http://vtrans.org/about\\_us.asp](http://vtrans.org/about_us.asp)
- Governor's Multimodal Strategic Plan for the Commonwealth of Virginia:  
[http://vtrans.org/resources/Strategic\\_Plan\\_12\\_01\\_10%20FINAL.pdf](http://vtrans.org/resources/Strategic_Plan_12_01_10%20FINAL.pdf)
- Secretary of Transportation page on Virginia Performs:  
<http://vaperforms.virginia.gov/agencylevel/src/secretariat.cfm?sec=Transportation>
- Virginia Performs Transportation Summary:  
<http://vaperforms.virginia.gov/indicators/transportation/summary.php>
- VDOT Performance Dashboard: <http://dashboard.virginiadot.org/Default.aspx>
- Virginia Center for Transportation Innovation and Research Report Database:  
<http://vtrc.virginiadot.org/PUBS.aspx>
- VDOT Business Plan:  
[http://www.vdot.virginia.gov/about/resources/2013\\_VDOT\\_Business\\_Plan.pdf](http://www.vdot.virginia.gov/about/resources/2013_VDOT_Business_Plan.pdf)

\* In addition to publicly available documents, this case study was augmented using information from an interview conducted April 26, 2012 with VDOT's Manager of Performance and Strategic Planning.

‡ This case study has been reviewed by VDOT's Performance and Strategic Planning Manager.

## 11. Georgia\*

### 11.1 Measures Used and Current Framework

GDOT publicly reports twelve performance measures, which are directly aligned with its four strategic goals (as listed in Figure 26). The four strategic goals are, in turn, aligned with statewide priorities set by the Governor of Georgia.

<p><b>Taking care of what we have, in the most efficient way possible</b></p> <ul style="list-style-type: none"> <li>• Percent of State-Owned Bridges Meeting GDOT Standards</li> <li>• Percent of Interstates Meeting GDOT Maintenance Standards</li> <li>• Percent of Non-Interstate Roads Meeting GDOT Maintenance Standards</li> </ul>	<p><b>Planning and constructing the best set of mobility-focused projects we can, on schedule</b></p> <ul style="list-style-type: none"> <li>• Percent ROW Authorized on Schedule</li> <li>• Percent CST Authorized on Schedule</li> <li>• Percent Projects Constructed on Schedule</li> <li>• Percent Projects Completed on Budget</li> <li>• Percent Highway Peak Hour Speeds (AM)</li> <li>• Percent Highway Peak Hour Speeds (PM)</li> <li>• Annual Congestion Costs</li> </ul>
<p><b>Making safety investments and improvements where the traveling public is most at risk</b></p> <ul style="list-style-type: none"> <li>• Annual Fatalities on Georgia’s Roadways</li> <li>• Average HERO Response Time</li> </ul>	<p><b>Making GDOT a better place to work [to] make GDOT a place that works better</b></p> <ul style="list-style-type: none"> <li>• [No performance measures reported]</li> </ul>

**Figure 26: GDOT’s four strategic goals with publicly reported performance measures.**

### 11.2 Measuring Progress toward Strategic Goals

Only some of GDOT’s performance measures are reported publicly; others are used for internal tracking, but not shown on the agency’s dashboard website.

As shown in Figure 27, each of GDOT’s publicly reported performance measures is associated with a strategic objective. GDOT’s 2011 Strategic Plan Update defines 40 strategic objectives related to its strategic goals. Most of these objectives are tracked with performance measures, with the only exceptions being in the areas of workforce efficiency and human resources (GDOT is currently developing measures in these areas).

GDOT’s performance measures also tend to be associated with performance targets, which provide a concrete understanding of whether or not progress is being made toward strategic goals.

Average HERO Response Time



**Description**

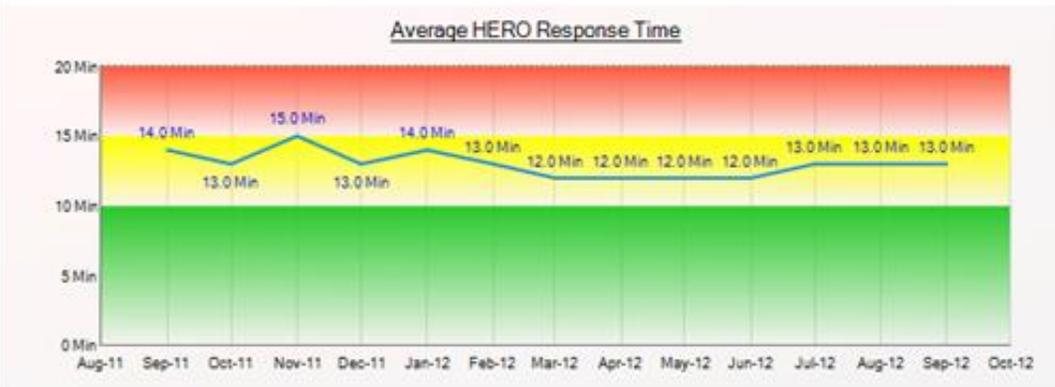
A roadway incident can delay traffic and present a hazard to travelers. By clearing a blocked lane one minute sooner, we could save our traveling public 4 to 6 minutes of delay. This measure tracks the time it takes a HERO unit to reach the scene from the time of notification.

**Strategic Objective**

Reduce the time that the traveling public is impeded by incidents. The target is to reduce incident response time to 10 minutes or less.

**Road to Improvement**

GDOT is exploring options to add resources to corridors with highest incident rates.



Date source: GDOT

Disclaimer: The Georgia Department of Transportation makes no representation or warranties, implied or expressed, concerning the accuracy, completeness, reliability, or suitability for any particular purpose of this information and data contained on this website.

Figure 27: Entry for Average Highway Emergency Response Time from GDOT’s online Performance Dashboard [accessed September 2012].

11.3 Using Performance Information in Decision Making

For any performance measure that is not within its target area (the green region in the dashboard graphics on Figure 27), GDOT describes a “road to improvement,” including actions that the agency is taking to improve performance. In its 2011 and 2012 Strategic Plan Updates, GDOT also defined “business strategies,” which are “activities required to achieve an objective, control a critical success factor, or overcome an inhibitor.” Many of these business strategies are directly linked to or dependent upon performance information. Some examples are shown in Table 2.

**Table 3: Examples of GDOT Objectives and Associated Strategies which are linked to or depend upon performance information.**

Objective	Strategy Using Performance Information
"Reduction in traffic congestion costs"	<ul style="list-style-type: none"> <li>• "For recurring congestion, focus is placed on most congested corridors..." This strategy depends on performance information related to congestion.</li> </ul>
"Maintain interstate bridges such that they can carry all legal loads [and], at minimum, have decks that are in good condition"	<ul style="list-style-type: none"> <li>• "Actively program preservation projects on existing bridges to reduce deterioration rate"- This strategy depends upon performance information related to bridge health.</li> </ul>
"Maintain the percentage of survey respondents that give GDOT a grade of A or B at 66.8% for meeting transportation needs in Georgia"	<ul style="list-style-type: none"> <li>• "Respond to online "Contact Us" form within 5 business days"-This strategy depends upon performance information related to customer service output.</li> </ul>
Complete "X"% of projects within the scheduled time.	<ul style="list-style-type: none"> <li>• "[Monitor] in-house engineering resources"- Here, performance measurement is explicitly part of the strategy.</li> </ul>

11.4 Performance Management in the Organizational Structure and Processes

GDOT’s performance management process is rapidly evolving. A re-organization of the agency in 2011 combined strategic development and performance measurement functions in the office of Organizational Performance Management (OPM), allowing for increased feedback between these two processes.

The OPM office reports to GDOT’s Chief Engineer, as do several Divisions related to construction, operations, and program delivery. The Chief Engineer, in turn, reports to the Transportation Commissioner and the State Transportation Board. However, the Director of Planning (in the Division of Planning) reports directly to the Governor. This arrangement was instituted by a law passed in the Georgia Legislature in 2009. With the Director of Planning reporting directly to the Governor, the level of influence that performance measurement information has on project selection is largely dependent on the extent to which the Director of Planning communicates this information to the Governor’s Office, and the extent to which the Governor and staff incorporate it in project selection decision making.

GDOT’s 2012 Strategic Plan Update acknowledges the following activities that are “essential to GDOT’s bedrock business processes [and] meeting future transportation needs”:

- Asset preservation and maintenance
- Identifying and selecting the best set of projects
- Delivering projects on time and on budget

At the time of this study, the office of OPM and other Divisions within GDOT’s engineering arm have direct influence over asset management and project selection,

while the Division of Planning has direct influence over project selection. Asset preservation and project delivery functions are tracked by OPM, which can help manage performance in these areas. There is no mechanism for tracking the effectiveness of project selection; however, the 2012 Strategic Plan Update indicates that “The Director of Planning uses various tools such as Project Prioritization Process (PrPP) in addition to institutional knowledge and coordination with local officials to help guide key decisions.” PrPP is further defined as “a quantitative approach to scoring certain capacity adding, operational and economic development projects by considering their benefits/costs and performance against an identified set of measures.”

### 11.5 Reporting

GDOT reports to the public via an online performance dashboard, which provides a snapshot of system performance measurement results. This report is automatically updated on a daily basis. Figure 27 shows an example entry from the performance dashboard. The agency also provides a written report to the Georgia Legislature on a periodic basis, and it reports to the State Transportation Board at in-person meetings.

### Sources

- GDOT Performance Dashboard Website:  
<http://www.dot.ga.gov/statistics/performance/Pages/default.aspx>
- 2011 Strategic Plan Update:  
<http://www.dot.state.ga.us/informationcenter/programs/Documents/Strategic/FY2011-StrategicPlan-FINAL.pdf>
- FY2012 Strategic Plan Update:  
<http://www.dot.ga.gov/aboutGeorgiadot/Documents/Strategic%20Development/FY12-StrategicPlan.pdf>
- GDOT Organizational Chart (Updated September 2012):  
[www.dot.state.ga.us/aboutGeorgiadot/Documents/Orgchart.pdf](http://www.dot.state.ga.us/aboutGeorgiadot/Documents/Orgchart.pdf)

\* In addition to publicly available documents, this case study was augmented using information from an interview with GDOT’s Director of Organizational Performance Management (July 27, 2012).

## 12. North Carolina<sup>‡</sup>

### 12.1 Measures Used and Current Framework

NCDOT defines goals for the Department and key strategies to achieve the goals in the long-range plan, as shown in Figure 28. Performance measures are developed for each of the five goals.

<p><b>Safer Transportation Network</b></p> <ul style="list-style-type: none"> <li>• Total Crashes &amp; Crash Rate</li> <li>• Total Fatalities &amp; Fatality Rate</li> <li>• Total Injuries &amp; Injury Rate</li> </ul>	<p><b>Employee Engagement</b></p> <ul style="list-style-type: none"> <li>• Commitment</li> <li>• Discretionary Effort</li> <li>• Intent to Stay</li> </ul>	<p><b>Infrastructure Health</b></p> <ul style="list-style-type: none"> <li>• Bridge Health</li> <li>• Pavement Condition</li> <li>• Roadside Feature Condition</li> </ul>
<p><b>Mobility</b></p> <ul style="list-style-type: none"> <li>• Incident Clearance Time</li> <li>• Ferry Service Reliability</li> <li>• Passenger Rail Reliability</li> <li>• Public Transit Utilization</li> <li>• Highway Reliability</li> </ul>	<p><b>Project Delivery</b></p> <ul style="list-style-type: none"> <li>• Percent of Projects on Schedule</li> <li>• Percent of Right of Way Plans Completed On Time</li> <li>• Percent of Construction Projects Completed on Schedule</li> <li>• Percent of Construction Projects Completed on Budget</li> <li>• Average Statewide Environmental Compliance Score</li> </ul>	

Figure 28: NCDOT’s Strategic Goals and Performance Measures from performance dashboard

### 12.2 Measuring Progress toward Strategic Goals

NCDOT has five goals driven by its mission, as shown in Figure 28. For each of these goals, there is a set of performance measures to track process results and gauge performance. NCDOT explicitly states that the measures are also used to establish expected targets. Annual targets are associated with each measure to monitor achievement towards the Department’s goals.

### 12.3 Using Performance Information in Decision Making

Setting strategic goals guides decision making at NCDOT and helps the agency to establish its investment strategy (shown in Figure 29). The performance measurement results are used to prioritize transportation needs and provide support information for project prioritization. Projects are ranked according to their ability to address the goals identified in NCDOT’s long-range plan and included in the program of projects accordingly. This process is called “Policy to Projects.”

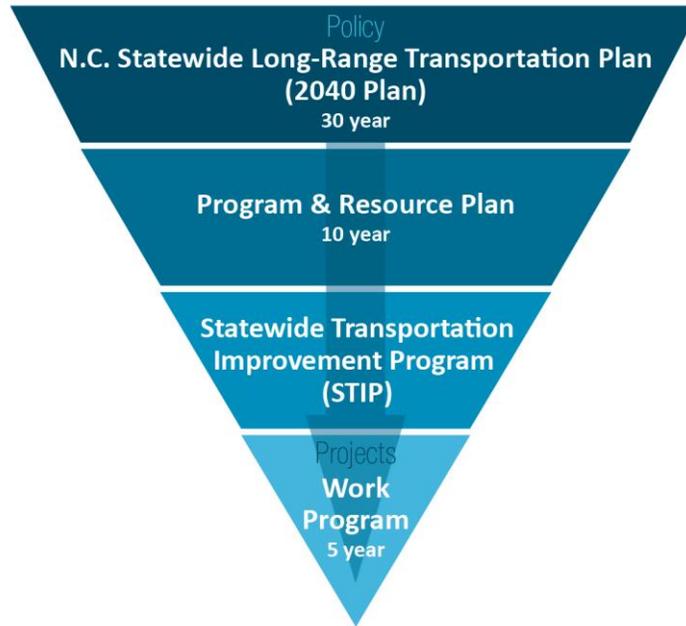


Figure 29: NCDOT’s investment strategy (as shown in Statewide Transportation Plan)

12.4 Performance Management in the Organizational Structure and Processes

As NCDOT reformed their project programming and planning process, they realigned their organizational structure, organizing business units along strategic functional basis. For example, the Strategic Planning Office of Transportation, the Transportation Planning Division, the Policy and Procedure Administration Division and Innovative Financing are all a part of Transportation Strategy and Investment Analysis, which is responsible for developing, monitoring, and managing long-range multimodal strategic planning and investment.

In addition, NCDOT implemented a Schedule Tracking and Reporting System (STaRS) to increase the reliability of data and consistency of reporting across the Department. STaRS is a scheduling and reporting tool for implementing the STIP. NCDOT uses STaRS to increase reliability, validity and accountability through universal use across.

12.5 Reporting

Organization performance is reported externally through an online dashboard (shown in Figure 30).

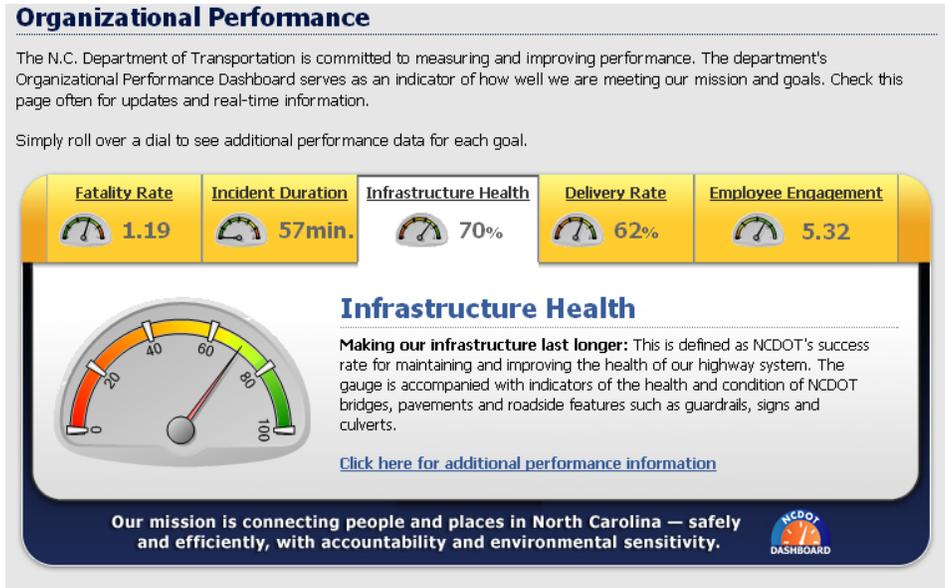


Figure 30: Screenshot from NCDOT’s online Organizational Performance Dashboard (accessed April 2012)

Through the dashboard site, quarterly “scorecards” are also available to provide at-a-glance information on past performance for the last quarter and year (shown in Figure 31). Annual reports are also available online for previous years.

**SFY 2011 First Quarter Performance Results**

Goal	#	Defined Performance Measure	SFY10 Result	SFY11 Target	SFY YTD Result
Make our transportation network safer	1.1	Statewide network crash rate	223.47	235 or less	202.8
	1.2	Statewide network fatality rate	1.24	1.66 or less	1.25
	1.3	Percentage of surveyed North Carolina drivers using a safety belt <sup>1</sup>	89.7%	90% or greater	89.7% <sup>1</sup>
Make our transportation network move people and goods more efficiently	2.1	Average statewide accident duration time	69.5 min.	75 min. or less	58 min.
	2.2	Travel time index of surveyed interstates	new measure <sup>4</sup>	1.35 or less	1.04 <sup>5</sup>
	2.3	Percentage of planned ferry runs completed as scheduled	97%	95.0% or greater	97.4%
	2.4	Rail service customer satisfaction index	new measure <sup>4</sup>	87% or greater	86%
	2.5	Percentage reduction in expected growth of commuter generated vehicle miles traveled	25.3%	25% or greater	25.3% <sup>1</sup>
	3.1	Percentage of bridges rated in good condition	62.5%	65.0% or greater	63.1% <sup>6</sup>

Figure 31: Screenshot from NCDOT’s quarterly scorecard (accessed April 2012)

An *Annual Performance Report* is available for download on NCDOT’s *Organizational Performance* website. The report includes performance data and narratives describing agency programs that have contributed to performance. Graphical elements of NCDOT’s *Annual Performance Report* include tables and bar charts using traffic light colors to identify performance levels and targets; maps; and high-quality photographs (see Figure 32).

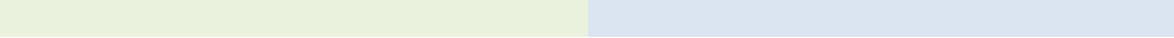


Figure 32: Example high-quality photographs from NCDOT's 2011 *Annual Performance Report*, illustrating (from left to right) a recently refurbished locomotive, an NCDOT truck pre-treating a roadway with salt brine, and flowers from the DOT's 25-year-old wildflower program.

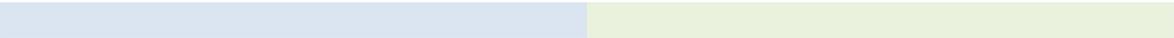
### Sources

- North Carolina Statewide Transportation Plan 2040: <http://www.ncdot.gov/performance/reform/2040Plan/>
- NCDOT Performance Dashboard: <https://apps.dot.state.nc.us/dot/dashboard/>
- NCDOT Performance Reports: <http://www.ncdot.gov/performance/reports/default.html>

‡ This case study has been reviewed by NCDOT's Transportation Planning Branch Group Manager.



## **V. Western States**



### 13. California\*†

#### 13.1 Measures Used and Current Framework

In 2012, California’s DOT (Caltrans) publicly reported results for 55 performance measures on a quarterly basis. Sixteen of these measures are reported as “key dashboard indicators” (KDIs), the “vital few” performance measures that Caltrans identified in its five-year strategic plan and reports quarterly to the state’s Business, Transportation and Housing (BTH) Agency. Other (non-KDI) performance measures have been “developed to guide Caltrans in its efforts to implement its five-year Strategic Plan and annual Operational Plan.” Each of Caltrans’ performance measures is directly associated with a specific strategic goal. The agency’s goals and related KDIs are listed in Table 3.

**Table 4: Caltrans' Strategic Goals and associated Key Dashboard Indicators (2012 Quarterly Report)**

<b>Strategic Goal</b>	<b>Key Dashboard Indicator</b>
<b>Safety</b>	<ul style="list-style-type: none"> <li>• Traveler Safety - Fatalities per 100 Million Vehicle Miles Traveled</li> <li>• Worker Safety - Number of Work-Related Fatalities</li> </ul>
<b>Mobility</b>	<ul style="list-style-type: none"> <li>• Percent of major incidents cleared in less than 90 minutes.</li> <li>• Total ridership on the State-supported intercity rail (segmented by route)</li> </ul>
<b>Delivery</b>	<ul style="list-style-type: none"> <li>• Project Approval and Environmental Document (PA/ED) – Percent of projects.</li> <li>• Right of Way (R/W) Certification – Percent of projects.</li> <li>• Ready to List (RTL) – Percent of projects.</li> <li>• Construction Contract Acceptance (CCA) – Percent of projects.</li> <li>• Cooperative agreements – Percent successfully developed within the 60-day performance measure.</li> <li>• Percent of projects with low bid within ±10% of engineer's estimate.</li> </ul>
<b>Stewardship</b>	<ul style="list-style-type: none"> <li>• Pavement condition – Percent of distressed lane miles.</li> <li>• Federal subvention formula funds obligated for local projects (on/off State highway system) – Percent of funds obligated.</li> <li>• Percent of total payments made to vendors and other government agencies within the time limits imposed by the Prompt Payment Act or as specified in the contract.</li> </ul>

**Service**

- "Request for Authorization to Proceed" packages submitted by local agencies that are reviewed and processed by Caltrans and are ready for submittal to Federal Highway Administration (FHWA) – Percent processed within 30 days of receiving the complete and accurate request.
- Percent of external survey respondents who said Caltrans was doing a good or excellent job.
  - User Survey
  - Stakeholder Survey

13.2 Measuring Progress toward Strategic Goals

Each of Caltrans’ publicly reported performance measures is directly related to a strategic goal, and more specifically related to a particular strategic objective. Each measure is also associated with a desired trend direction (increasing or decreasing), and most have a numerical target.

Caltrans’ performance measurement tools seem to be highly developed in comparison to those of other states. Nonetheless, the Department makes occasional revisions to its performance measurement process in “an ongoing effort in response to... management needs” and other pressures. For example:

- The methodology used to measure statewide vehicle hours of delay was changed in 2009 in order to be more descriptive of an average user’s experience; instead of sampling from only the slowest lane of traffic, the delay measure is now based on data from all lanes.
- Prior to 2010, Caltrans reported farebox ratio for each of its intercity rail routes, but changed to reporting only revenues after “the State has switched to fixed price contracts,” and therefore “the expenses charged to the State do not reflect actual operational expenses, making the calculation of a farebox ratio (revenues divided by expenses) no longer valid.”
- The performance measure and target related to developing cooperative agreements with local agencies was adjusted in 2009.
- It has been difficult to quantify whether Caltrans projects are meeting their stated goals, so performance measures are still under development to capture this outcome.

Changes to the performance measurement process and other issues that might impact a user’s interpretation of performance information (such as data variability) are clearly documented in the *Quarterly Performance Report*.

13.3 Using Performance Information in Decision Making

Figure 34 illustrates how Caltrans integrates performance metrics into their overall planning process.

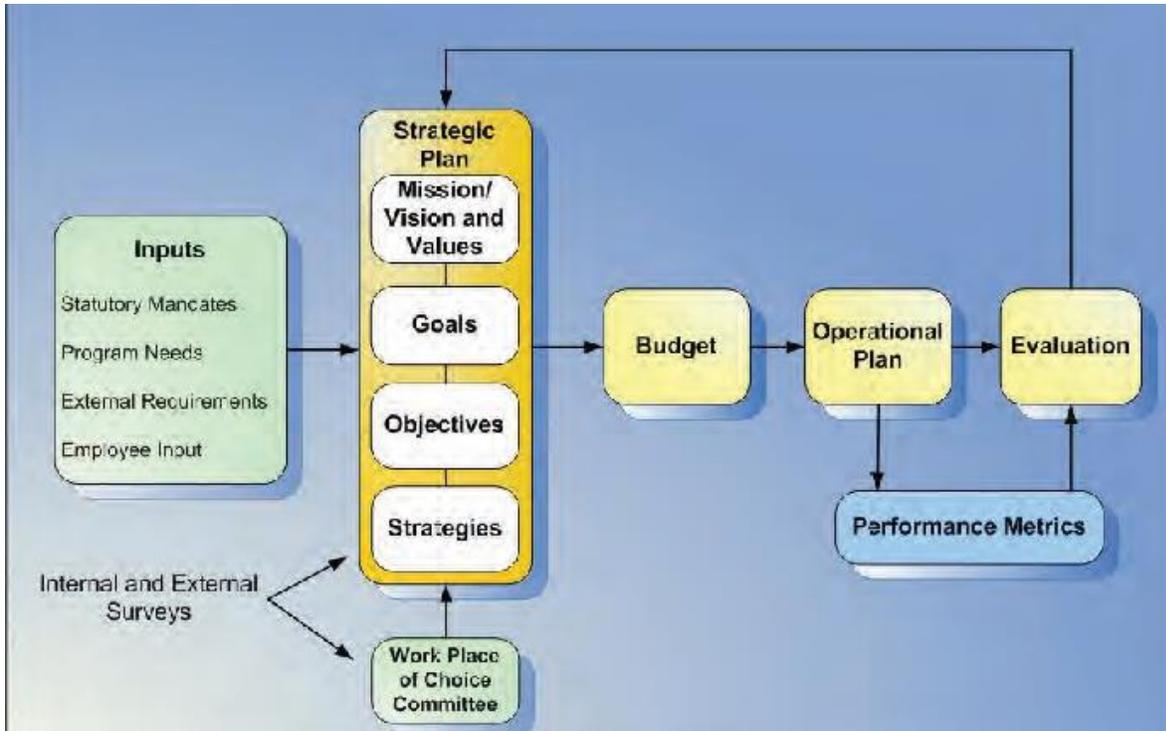


Figure 33: Caltrans' decision making framework including strategic planning, budgeting, an operational plan and performance measurement (From the 2007-2012 Strategic Plan).

As shown in Figure 33, Caltrans' *Strategic Plan* includes a number of “strategies” associated with its goals and objectives. Goals, objectives and strategies in a current strategic plan are all informed by performance information gleaned during the implementation of the previous strategic plan.

As part of implementing its *Strategic Plan*, Caltrans describes its *Quarterly Performance Report* as “a resource to guide management in decision making... so that future decisions will improve Caltrans performance.” Some decision-making processes that are being undertaken to address performance issues include the following:

- Since Caltrans has not been meeting its target that 60% of major incidents should be cleared within 90 minutes, the agency is (a) developing a process by which to evaluate the causes of major incidents, and (b) revising data collection methods, software tools, and new policies that can be jointly implemented with California Highway Patrol.
- Caltrans published its *Transportation Management Plan Guidelines* in 2009, documenting strategies that may be used to decrease or mitigate travel delay. The agency uses Transportation Management Plans throughout its districts, and tracks effectiveness through the Daily Vehicle Hours of Delay measure.
- Caltrans uses several performance measures and targets related to employee satisfaction, all of which support the performance target of keeping annual attrition rates below 4%.
- Tracking the time to completion for work tasks, such as permit approvals, has encouraged efficiency over time.

### 13.4 Performance Management in the Organizational Structure and Processes

In early 2012, Caltrans was one of 12 departments in California's Business, Transportation and Housing (BTH) agency. Within Caltrans, the Office of Strategic Management (formerly the Office of Strategic Planning and Performance Management) implements performance based management within the Department, and it serves as a liaison to other departments within BTH on performance-based management issues.

Other activities of this Office include the following:

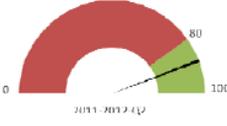
- Developing and updating the Strategic Plan;
- Periodically updating the Operational Plan;
- Collecting data and preparing the quarterly Performance Measures report;
- Collecting data and preparing the quarterly Stewardship Report to the Federal Highway Administration;
- Procuring consultant services for the Caltrans' biennial Stakeholder Survey
- Participating in a review and advisory capacity Department initiatives and special projects such as, but not limited to, Smart Mobility, the California Transportation Plan, Transportation System Information, and Research and Innovation Projects.

In collecting and publishing performance data, Caltrans' Office of Strategic Management interacts with many other functional units (Divisions and Offices) throughout the Department. Not every functional unit has performance measures, but most of those who do monitor their own progress toward performance targets and make decisions about how to improve performance. Decisions based on performance information tend to be made at least as often as performance data is reported (quarterly). Beyond providing raw data for the quarterly performance report, most of these other functional units also provide commentary about performance trends.

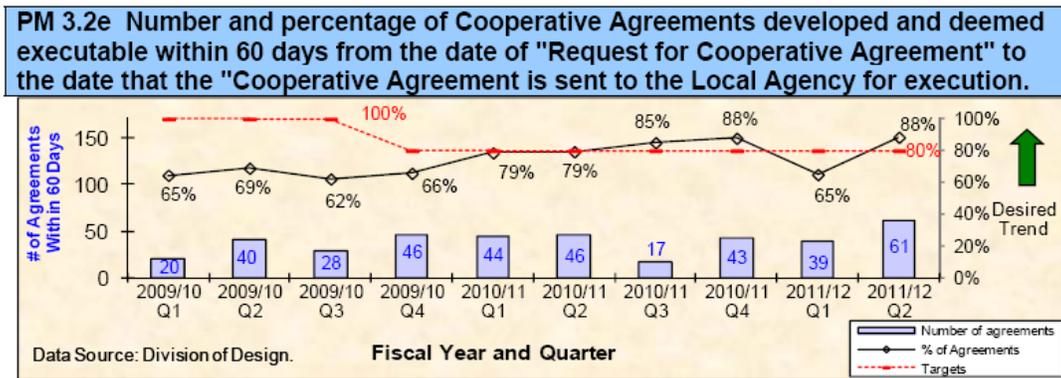
Many of Caltrans' strategic goals are supported by performance measures in multiple Divisions. Top and mid-level management help to define the outcome-oriented performance measures (KDIs) to track strategic agency-level performance, while front-lines employees also contribute to defining performance measures that relate directly to their functional areas.

### 13.5 Reporting

Caltrans uses the Performance-Based Management System (PBMS), a data warehouse reporting system deployed via a secure web portal by the Business, Transportation and Housing (BTH) Agency, to report KDI performance on a quarterly basis. Also, a *Quarterly Performance Report* is publicly available on the web. The *Quarterly Performance Report* opens with a summary list of which measures are meeting their targets, followed by a dashboard-style update on KDIs, and finally in-depth time-series data and commentary for each of the agency's 55 publicly reported performance measures (example graphics are provided in Figures 33 and 34).

Performance Measure	Baseline	Target	Current Data	Comments
Delivery milestones for capital projects. Current data represents the percent of projects that met the planned delivery milestones.				
PM 3.2e Cooperative agreements – Percent successfully developed within the 60-day performance measure. 	40	>80	88	This measure is reported quarterly. Baseline reflects the percent of cooperative agreements in FY 2009/10 that were successfully developed within the 60-day performance measure.  Out of a total of 69 agreements developed from October 1, 2011 through December 31, 2011, and measured according to the 60-day performance criteria, sixty-one (61) agreements (or 88%) were developed within 60 days or less, while eight (8) agreements (or 12%) took longer than 60 days to develop.

**Figure 34: Example entry from the Key Dashboard Indicators summary in Caltrans' Quarterly Performance Report**



**Figure 35: Example entry from the detailed "Trends and Progress" section of Caltrans' Quarterly Performance Report**

Real-time traffic data for State roadways is provided via Caltrans' "Quickmap." The map shows travel speeds, on a color scale from slow to fast, the locations of lane closures, incidents, message signs, cameras, and chain controls. It has the option of zooming to different metropolitan areas or of scrolling around the state.

**Sources**

- Caltrans Office of Strategic Planning & Performance Management Website: <http://www.dot.ca.gov/perf/> (Accessed September 2012)
- Caltrans Organizational Chart: <http://www.dot.ca.gov/orgchart/departamentalorgchart.pdf> (Accessed September 2012)

\* In addition to publicly available documents, this case study was augmented using information from an interview with a representative from Caltrans' Office of Strategic Management (April 25, 2012).

‡ This case study has been reviewed by a representative from Caltrans' Office of Strategic Management.

## 14. Oregon\*\*

### 14.1 Measures Used and Current Framework

Oregon DOT (ODOT) has 25 "key performance measures" (KPMs) that were legislatively approved for the 2009-2011 Biennium. As described in ODOT's Annual Performance Progress Report (APPR), KPMs are "those highest-level, most outcome-oriented performance measures that are used to report externally to the Legislature and interested citizens" and "communicate in quantitative terms how well the agency is achieving its mission and goals." Each KPM is explicitly associated with one of five goals (Safety, Mobility, Preservation, Sustainability/Environment, and Stewardship; see Table 4 for associated KPMs). Many KPMs are also associated with one of the State of Oregon's 91 "benchmarks." Figure 36 shows the State's "Oregon Shines Goals" and seven categories of benchmarks. Some benchmarks that are supported by ODOT's performance measures include "preventable death," "traffic congestion," "independent seniors," and "net job growth."



Figure 36: Oregon's Statewide goals and Benchmark Categories. ODOT associates many of its performance measures with benchmarks in the Economy, Social Support, Built Environment, and Natural Environment categories.

Beyond being reported in the APPR, some KPMs are updated on a quarterly basis or by geographic area, and used for internal management. Several of ODOT's divisions also use more detailed measures internally as they carry out their functions.

**Table 5: ODOT's Goals and Related Key Performance Measures (2011 APPR)**

<b>Goal</b>	<b>Key Performance Measures</b>
<p><b>Safety:</b> Engineer, educate and enforce a safe transportation system</p>	<ul style="list-style-type: none"> <li>• Traffic fatalities per 100 Million VMT</li> <li>• Traffic injuries per 100 Million VMT</li> <li>• Percent of all vehicle occupants using safety belts</li> <li>• Number of large truck at-fault crashes per million VMT</li> <li>• Number of highway-railroad at-grade incidents</li> <li>• Number of train derailments caused by human error, track, or equipment</li> <li>• Percent of public satisfied with transportation safety</li> </ul>
<p><b>Mobility and Economic Vitality:</b> Keep people and the economy moving</p>	<ul style="list-style-type: none"> <li>• Hours of travel delay per capita per year in urban areas.</li> <li>• Average number of special transit rides per each elderly and disabled Oregonian annually</li> <li>• Number of state-supported rail service passengers.</li> <li>• Percent of Oregon communities of 2,500 or more with intercity bus or rail passenger service</li> <li>• Percent of Oregonians who commute to work during peak hours by means other than Single Occupancy Vehicles.</li> <li>• Number of jobs sustained as a result of annual construction expenditures</li> </ul>
<p><b>Preservation:</b> Preserve and maintain transportation infrastructure</p>	<ul style="list-style-type: none"> <li>• Percent of pavement lane miles rated "fair" or better out of total lane miles in state highway system</li> <li>• Percent of state highway bridges that are not distressed</li> </ul>
<p><b>Sustainability and Environment:</b> Sustain the environment and communities</p>	<ul style="list-style-type: none"> <li>• Number of high priority ODOT culverts remaining to be retrofitted or replaced to improve fish passage</li> <li>• Percent of urban state highway miles with bike lanes and sidewalks</li> </ul>
<p><b>Stewardship:</b> Maximize value from transportation investments</p>	<ul style="list-style-type: none"> <li>• Percent of projects going to construction phase within 90 days of target date</li> <li>• Percent of projects with the construction phase completed within 90 days of original contract completion date</li> <li>• Percent of original construction authorization spent</li> <li>• Percent of ODOT contract dollars awarded to Disadvantaged Business Enterprise (DBE) businesses</li> <li>• Percent of customers rating their satisfaction with the agency's customer service as "good" or "excellent": overall customer service, timeliness, accuracy, helpfulness, expertise, and availability of information</li> <li>• Field office wait time (in minutes), Phone wait time (in seconds), and Title wait time (in days) at the Driver and Motor Vehicles Division</li> </ul>

## 14.2 Measuring Progress toward Strategic Goals

According to the 2011 APPR, "Performance measures help communicate ODOT priorities from executive staff to the front line." In this vein, Key Performance Measures (KPMs) are aligned with 5 agency goals, as shown in Table 4. Each KPM is associated with a desired trend direction, and many also have numerical targets. Some targets change from year to year, to encourage improvement in the desired trend direction each year. Other targets are set for a multi-year time frame, and then adjusted once the time frame has elapsed or the target has been achieved. For each KPM, the APPR describes ODOT's strategies for achieving performance, explains the desired trend or target, interprets performance results for at least the past year, compares ODOT's performance with trends in the nation or peer states, describes factors that may affect results, and identifies "what needs to be done" next in order to maintain or improve performance.

## 14.3 Using Performance Information in Decision Making

ODOT's Annual Performance Progress Report (APPR) describes the role of performance information in decision making as follows:

*"There is the need for performance information to help support the department, which decentralizes decisions and places accountability on the front line. Continued training efforts focus on helping frontline staff more successfully deliver effective ODOT programs in a changing and decentralized environment. ... In addition, staff use measures as a tool to communicate about challenges or obstacles to be addressed at the executive level. Continued training efforts in the use of performance measures will enhance ODOT's ability to quickly respond in order to be more efficient and effective."*

A comprehensive employee survey of ODOT in 2000 found that 60% of the agency's staff members used performance information to make decisions. Although ODOT's performance management system has changed since that time, to a more centralized structure, several divisions are still very explicit about using performance information in their decisions. For example, ODOT's Division of Driver and Motor Vehicle Services (DMV) maintains an internal dashboard that allows it to reassign staff resources on a weekly basis. This internal dashboard tracks completion and backlogs associated with every work task and service provided by DMV. Each DMV employee is trained in a second job within the division, other than their primary job, so that backlogs can be addressed with increased human resources when needed.

## 14.4 Performance Management in the Organizational Structure and Processes

ODOT's Key Performance Measures (KPMs) are defined by the executive team, with input from each division and assistance from the Oregon Progress Board. KPMs are then submitted to the Ways and Means Committee of the Oregon Legislature for review and approval during the biennial budgeting process. Then, ODOT's various divisions

become “owners” of the KPMs- they track performance and make decisions based on this information.

Most divisions within ODOT have monthly or quarterly performance update reports, which are shared and discussed at staff meetings. Some divisions, including Driver and Motor Vehicle Services, Financial Services, and Bridge Engineering, also use internal performance dashboards to track and adjust performance on a more frequent basis.

KPMs are compiled into the APPR by ODOT’s Central Services Division, which also deals with civil rights, external audits, financial services, HR, contracts, and other support services. Within this division, a Performance Measurement Manager and one additional half-time position serve as a “Performance Advisory Team,” an optional resource available to assist other ODOT divisions in “developing and refining performance measures and gathering source data.” This team manages ODOT’s online Performance Dashboard, as well as internal dashboard systems for those other divisions which have chosen to use them.

In the 1990s, the Performance Measurement Manger position was part of a larger team, the Office of Productivity, which included seven full-time positions dedicated to performance monitoring, activity-based costing, and linking ODOT’s activities to desired outcomes. Centralized productivity monitoring was downscaled and made into an optional resource in the early 2000s when ODOT chose to “decentralize decisions and place accountability on the front line.” The agency determined that it could increase morale and employee acceptance of performance management when it was incorporated into each division’s job description rather than enforced by a centralized office.

#### 14.5 Reporting

In the Annual Performance Progress Report (APPR), made available every fiscal year, ODOT provides time series charts with achieved values and targets for its key performance measures (KPMs). The same information is provided online at the ODOT Performance Dashboard website (an example entry is shown in Figure 37). Also available online, a printable, one-page overview of KPMs summarizes goals, outcomes, targets, and dashboard status (green, yellow, red) in table form.

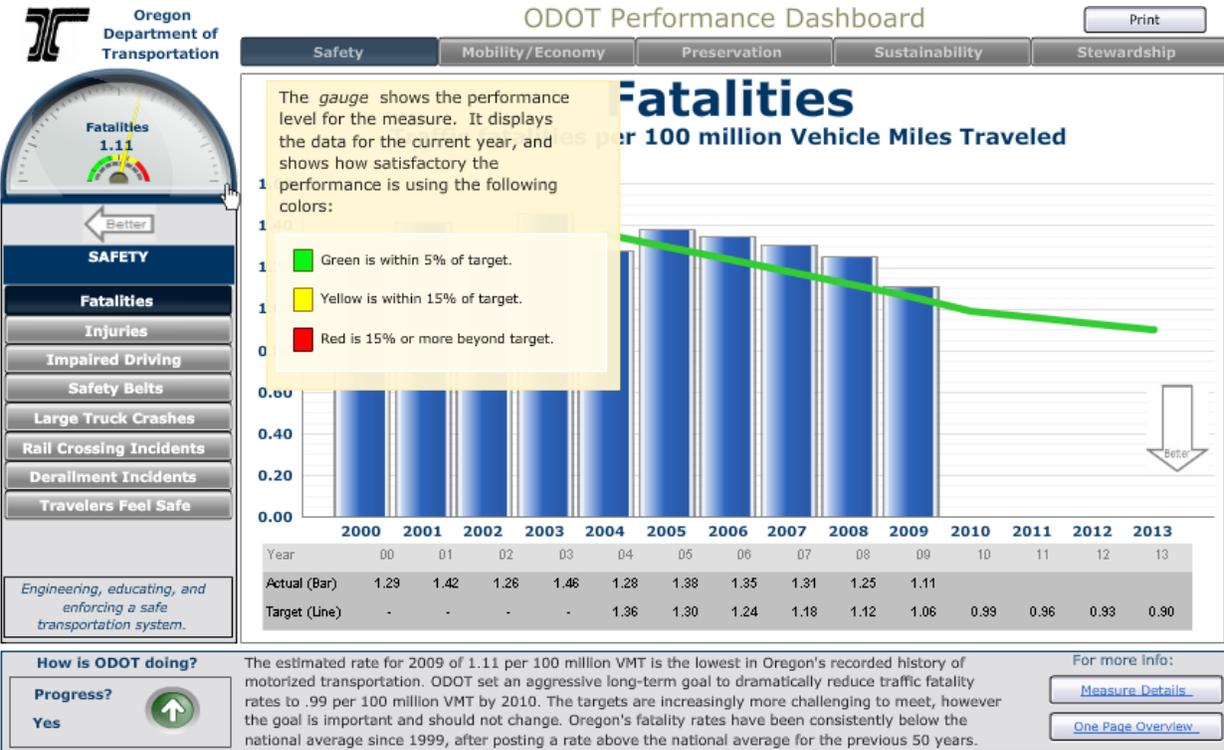


Figure 37: Screenshot of the ODOT Performance Dashboard website, including pop-up legend.

The dashboard shown in Figure 37 was first developed for internal use by ODOT managers. It was later made public as executive staff became comfortable that it was accurate and easily understood, and as stakeholders such as the state legislature required more transparency and reporting. Similar, but more detailed dashboards are used for internal management purposes in some of ODOT’s divisions.

Other reporting mechanisms, which are not explicitly linked to the performance management program, include:

- TripCheck website, which provides real-time traffic data including closures, estimated delay times, weather hazards, construction sites, truck restrictions, and the opportunity to view regularly updated visuals from traffic cameras
- Social media pages like Facebook and Twitter provide “important news” as well as information about “interesting but often lesser-known programs and projects.”

Sources

- ODOT Performance Measurement Website  
<http://www.oregon.gov/ODOT/CS/PERFORMANCE/Pages/index.aspx>
- Oregon Progress Board Website  
<http://benchmarks.oregon.gov/>
- ODOT Social Media Tools Website  
[http://www.oregon.gov/ODOT/pages/social\\_media.aspx](http://www.oregon.gov/ODOT/pages/social_media.aspx)

\* In addition to publicly available documents, this case study was augmented using information from an interview with ODOT's Performance Measurement Manager, in the Division of Central Services (June 14, 2012).

‡ This case study has been reviewed by ODOT's Performance Measurement Manager.

## 15. Utah<sup>‡</sup>

### 15.1 Measures Used and Current Framework

Utah DOT (UDOT) publishes an annual *Strategic Direction and Performance Measures* report, showing measures associated with funding sources and expenses, “the challenge” faced by UDOT, and each of the agency’s 5 strategic goals, as listed in Table 5.

**Table 6: Goals, Measures and Strategies described in UDOT's 2012 "Strategic Direction and Performance Measures" report**

<b>Context</b>	<b>Example Measures</b>	<b>Management Strategies</b>
<b>Funding Inputs and Outputs</b>	<ul style="list-style-type: none"> <li>• Percentage of incoming funds by source</li> <li>• Percentage of expenditures by category</li> </ul>	[No strategies listed for these measures]
<b>The Challenge</b>	<ul style="list-style-type: none"> <li>• Growth in population and VMT has outpaced increased growth in new roadway capacity</li> </ul>	<ul style="list-style-type: none"> <li>• Develop strategic goals</li> <li>• Use performance measures to help achieving goals</li> </ul>
<b>Final Four Goal: Preserve Infrastructure</b>	<ul style="list-style-type: none"> <li>• International Roughness Index (IRI)</li> <li>• Bridge Condition Rating</li> </ul>	<ul style="list-style-type: none"> <li>• Prioritize roadways based on the volume of daily traffic.</li> <li>• Proactively invest to maintain infrastructure condition, lengthen useful life, and avoid the need for major rehabilitation</li> </ul>
<b>Final Four Goal: Optimize Mobility</b>	<ul style="list-style-type: none"> <li>• Total hours of delay per day</li> <li>• People throughput, vehicle throughput, and crashes in HOV lanes, compared with general purpose lanes</li> <li>• Intersection wait times and average delay times at innovative interchanges that have been built</li> <li>• Travel time, agency cost, and user cost reductions due to signal timing improvements</li> <li>• Presence of public information services</li> </ul>	<ul style="list-style-type: none"> <li>• Add capacity on select routes</li> <li>• Increase efficiency of managed lanes</li> <li>• Identify locations for innovative cross-road configurations, based on performance of those that have been built</li> <li>• Improve signal coordination</li> <li>• Provide broad access to traffic information</li> </ul>
<b>Final Four Goal: Improve Safety</b>	<ul style="list-style-type: none"> <li>• Number of fatalities</li> <li>• Interstate serious injury and fatal crashes involving a vehicle that crossed the median, versus total miles of cable barrier installed</li> </ul>	<ul style="list-style-type: none"> <li>• Identify causes of crashes and address them through                             <ul style="list-style-type: none"> <li>○ Infrastructure treatments</li> <li>○ Public outreach</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>• Number of snowplow staff and winter operations budget</li> </ul>	<ul style="list-style-type: none"> <li>• Control snow and ice</li> </ul>
<p>Final Four Goal: <b>Strengthen Economy</b> (New as of 2012)</p>	<ul style="list-style-type: none"> <li>• Relationship between GDP and VMT</li> <li>• User Cost Savings for major projects completed in the last year</li> <li>• Number of jobs created</li> </ul>	<ul style="list-style-type: none"> <li>• Price plus time (P+T) bidding</li> <li>• Accelerated bridge construction</li> </ul>
<p>Goal: <b>Delivering Results</b></p>	<ul style="list-style-type: none"> <li>• Monthly construction payments</li> </ul>	<ul style="list-style-type: none"> <li>• Track construction and pre-construction activities separately</li> </ul>

In addition to what is reported in the *Strategic Direction and Performance Measures* report, UDOT also collects and uses more detailed performance data related to asset management (particularly for pavements and bridges), safety (segregating crashes by cause), and agency finances. The 2012 *UDOT Dashboard* website provides performance information related to travel times, fatalities, on-time and on-budget project delivery, and infrastructure condition.

15.2 Measuring Progress toward Strategic Goals

An innovative feature of UDOT’s 2012 *Strategic Direction and Performance Measures* report is its incorporation of forecasted performance estimates with historical time series data. For example:

- Pavement condition is forecasted through 2016, based on allotted funding
- Daily hours of delay is forecasted through 2040, showing delay savings for different investment scenarios

This reporting of forecasted performance can help illustrate how the agency’s actions affect changes over time while at the same time demonstrating that the agency takes performance information into consideration when it allocates resources.

The Strategic Direction and Performance Measures report also includes a list of “2011 Accomplishments” from the previous year and “2012 Goals” for the upcoming year for each of the “final four” Strategic Goals. The list of previous year’s accomplishments highlights projects that were completed by the agency, but it also acknowledges when something undesirable has occurred, such as “the pavement condition for Level 2 roads trended downward.” The list of current year goals is directly linked to what was measured for the previous year; for example, “reverse or slow the pavement condition decline for Level 2 roads.”

15.3 Using Performance Measures in Decision Making

Utah’s Transportation Commission is responsible for prioritizing transportation projects and deciding how funds are spent. As described on UDOT’s website, the Commission uses a Decision Support System (DSS), which provides a “data-driven analysis of the

relative strengths” of proposed capacity projects, “based on functional classification of the facility, current and projected future traffic volumes, truck traffic, and safety benefits.” The DSS provides project rankings, which the Commission then uses in deciding which projects from the long-range plan should be added to the Statewide Transportation Improvement Program (STIP).

Web pages for various divisions within UDOT allude to how they use performance information in decision making. For example:

- Pavement Management Engineers use several types of performance data to make asset management decisions.
- The Risk Management Division periodically analyzes loss reports (histories of insurance claims provided by an insurance company) to identify ways to improve safety on construction sites.
- The Traffic and Safety Division, has conducted research to identify, and then address the top five behaviors causing crashes on Utah roads: drowsy driving, distracted driving, aggressive driving, impaired driving and not buckling up. The division reports that their initiatives, in coordination with partners in other Departments, have led to a 37% percent decline of crashes on Utah's roads over 10 years.

In 2011, UDOT began using a GIS web application called UPlan to synchronize plans and projects with other state agencies, local governments, federal agencies, utility companies, and within the Department’s many divisions and regions. As described in the annual *Accomplishments and Efficiencies* report, “UPlan is an interactive planning and analysis tool developed by the Department that provides access to data to support informed discussions and decisions.”

#### 15.4 Performance Management in the Organizational Structure and Processes

In general, performance management is decentralized throughout UDOT. However, some centralization exists. For example:

- UDOT’s Division of Systems Planning and Programming is responsible for monitoring transportation system conditions, and then using this information to identify transportation needs, establish transportation plans, and determine program and project schedule. The work of this division is directly linked to the Utah Transportation Commission’s selection of projects for the STIP.
- The Comptroller’s Office within the Administrative Services Division provides UDOT’s executive decision makers with financial data related to project and federal-aid accounting, budget and financial reporting, and general accounting.

UDOT’s annual *Efficiencies and Accomplishments* report highlights notable achievements throughout the agency, describing activities that saved money for either UDOT or its customers, or that increased UDOT’s efficiency in another way. Prior to 2011, this report was organized by functional unit, and by strategic goal. At that time, this report was primarily an internal document used to share information across UDOT’s

57 functional units, and to provide ideas for new performance measures. In 2012, the report changed orientation, addressing more of a public audience.

15.5 Reporting

UDOT produces its *Strategic Direction & Performance Measures and Efficiencies and Accomplishments* reports as annual summaries, which are available on the agency website. Similar performance information as that found in the *Strategic Direction and Performance Measures* report is also provided on the State of Utah’s central performance measurement website: *Utah Performance Elevated*.

Both the *Strategic Direction & Performance Measures* report and *Utah Performance Elevated* website include time series graphics and some other graphical elements. In 2012 UDOT created an online performance dashboard, which presents performance information in a graphical format only. Figure includes sample images from the *UDOT Dashboard*.

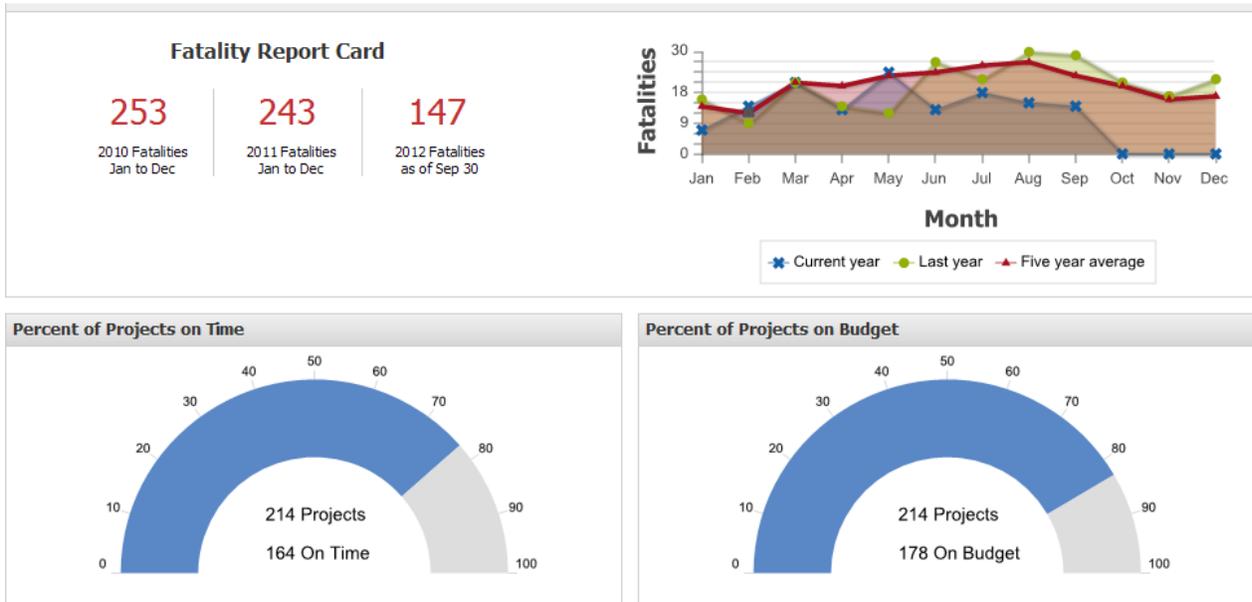


Figure 38: Sample images from *UDOT Dashboard* website, accessed October 2012.

Unlike the graphics provided on the *UDOT Dashboard*, on the *Utah Performance Elevated* website, and in the *Strategic Direction & Performance Measures* report, the *Efficiencies and Accomplishments* reports use graphical elements such as photographs, maps and diagrams to highlight particular initiatives, projects and programs. Figure 39 shows an example graphic from the report, which is adjacent to a section that describes how the new UPlan application has “reduced time to prepare environmental documents” and therefore saved “up to \$54,000 annually in project costs for future years.”

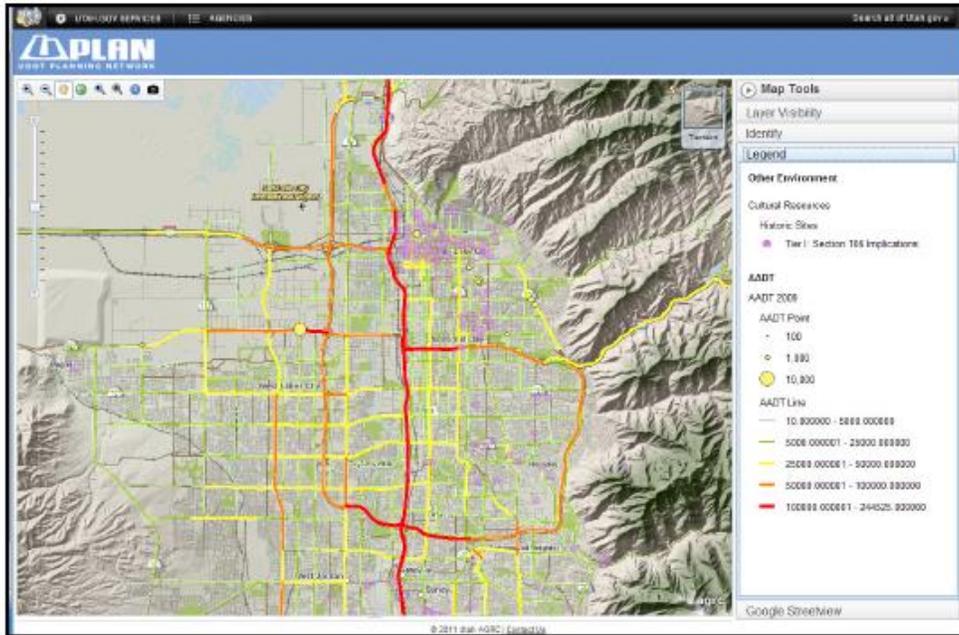


Figure 39: Screenshot of the UPLAN GIS application, as provided in UDOT’s 2011 *Efficiencies and Accomplishments* report.

Some more detailed performance data is provided online for certain programs and functional units throughout UDOT. For example:

- More detailed, annual data is reported for vehicle crashes as part of UDOT’s “Zero Fatalities” initiative.
- The Systems Planning and Programming Division collects and reports on a variety of activities, with reports available through the UDOT website, for example monthly traffic statistics, and asset management data.
- Two of UDOT’s regional offices produce their own performance reports, which include more performance measures and at a finer timescale (often monthly) than the agency-wide report:
  - Region 2’s annual *Final Accomplishments, Challenges, and Tactics Summary* (FACTS)
  - Region 4’s annual *Performance Model* report (example graphic shown in Figure 40)
- UDOT’s “Projects” website provides an interactive map that users can search or browse for ongoing projects that are in the design or construction phases.
- A “CommuterLink” website provides real-time traffic data including incidents, construction and weather, and traffic camera images. Linked to this page is an air quality alert service and other emergency alerts to show, for example, land slide locations and road closures.



Figure 40: Innovative dashboard graphic from UDOT Region 4’s 2012 *Performance Model*, showing the number of bridges in poor, fair and good condition.

The annual *Efficiencies and Accomplishments* report has been used to generate ideas that eventually reach broader audiences through such media as press releases, articles for the Transportation Research Board, and "library sessions." UDOT also uses social media pages like Facebook and Twitter to share information related to specific projects, initiatives, and corridors.

### Sources

- *Performance Utah* Website <http://performance.utah.gov/agencies/udot.shtml>
- "Inside UDOT" Webpage includes links to other UDOT divisions, as well as the Strategic Direction and Performance Measures report and the Accomplishments and Efficiencies report. <http://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:33>,
- *UDOT Dashboard* Website <http://dashboard.udot.utah.gov/>
- UDOT's *Projects* interactive map <http://www.udot.utah.gov/projects/f?p=250:3005:0::NO:3005>

‡ This case study has been reviewed by UDOT's Director of Asset Management.

## 16. Washington\*\*†

### 16.1 Measures Used and Current Framework

Washington State DOT (WSDOT) tracks more than 100 performance measures relating to both transportation system outcomes and organizational efficiency. In the agency’s acclaimed quarterly performance report, the “Gray Notebook” (GNB), selected performance measures are highlighted each quarter and grouped according to the most relevant of WSDOT’s six “policy goals.” These transportation policy goals (listed in Table 7) are defined by the Washington State legislature. Some of the measures reported in GNB are defined as “key performance measures” associated with these policy goals, and they are identified in the agency’s “Business Directions” Strategic Plan. Other performance measures are used by various WSDOT divisions and offices in their day-to-day functions. Overall, performance data is used to make strategic investment decisions and influences budget decisions. A subset of transportation performance measures is tracked separately by Washington State’s Office of Financial Management as part of its biennial Transportation Attainment Report (these are shown in Table 7), and another, smaller, subset is regularly reviewed by the Governor through the inter-agency Transportation Dashboard.

**Table 7: WSDOT's performance goals and measures tracked by Washington State's Office of Financial Management**

State Policy Goal	Select Performance Measures
<b>Safety</b> – to provide for and improve the safety and security of transportation customers and the transportation system	<ul style="list-style-type: none"> <li>• Number and rate of traffic fatalities per 100 million vehicle miles traveled (VMT)</li> <li>• Number of collisions and percentage resulting in serious or fatal injuries</li> </ul>
<b>Preservation</b> – to maintain, preserve, and extend the life and quality of prior investments in transportation systems and services	<ul style="list-style-type: none"> <li>• Percent of state highway pavement in fair or better condition</li> <li>• Percent of state bridges rated structurally deficient (SD)</li> <li>• Percent of state ferry terminals in fair or better condition</li> </ul>
<b>Mobility</b> – to improve the predictable movement of goods and people throughout the state	<ul style="list-style-type: none"> <li>• Annual hours of delay per traveler on major corridors in greater Seattle and Spokane areas</li> <li>• Annual hours of delay avoided through operational or public transportation enhancements</li> <li>• Usage of HOT lanes on SR 167</li> <li>• Usage of Seattle-area network of HOV lanes by Person Miles Traveled (PMT)</li> <li>• Percentage of commute trips taken while driving alone</li> </ul>

	<ul style="list-style-type: none"> <li>• Ridership and percent of trips on time for Washington State Ferries</li> <li>• Ridership and percent of trips on time for Washington and Amtrak-sponsored Cascades train service</li> </ul>
<p><b>Environment</b> – to enhance Washington’s quality of life through transportation investments that promote energy conservation, enhance healthy communities, and protect the environment</p>	<ul style="list-style-type: none"> <li>• Number of culverts fixed and miles of stream habitat opened up for fish passage</li> <li>• Number of storm water treatment facilities constructed</li> <li>• Tons of greenhouse gases produced statewide</li> </ul>
<p><b>Stewardship</b> – to continuously improve the quality, effectiveness, and efficiency of the transportation system</p>	<ul style="list-style-type: none"> <li>• Percent of 2003 (Nickel) and 2005 (Transportation Partnership Act or TPA) revenue packages’ capital projects completed on-time and on-budget</li> </ul>
<p><b>Economic Vitality</b> – to promote and develop transportation systems that stimulate, support and enhance the movement of people and goods to ensure a prosperous economy</p>	<ul style="list-style-type: none"> <li>• Number of jobs created or sustained by transportation projects</li> <li>• Amount of freight cargo moving in, out and within Washington through the air, by water or by rail</li> </ul>

16.2 Measuring Progress toward Strategic Goals

As part of its “Business Directions” Strategic Plan, WSDOT defines multiple objectives, strategies, driving forces, and performance measures associated with each policy goals. The strategic plan defines each of these components as follows:

- The goals are interdependent and support the overall vision for transportation in the state.
- Each policy goal is addressed by a series of objectives that spell out what the agency aims to achieve.
- Strategies show the near-term work and activities the agency plans to take to realize its objectives.
- Driving forces are the most dominant factors influencing the agency today. These “drivers” present both risks and opportunities in each of policy goal areas, and were used in crafting the strategies and objectives for the next six years.
- Performance measures are assessments of projects and programs that track performance results against specific strategic actions.

WSDOT has historical trend data for all of its performance measures, and defines a desirable direction for each measure in order track whether agency performance is moving toward strategic goals. Numerical targets are used, but not for every measure, and they are not necessarily associated with a defined time frame for achievement.

### 16.3 Using Performance Information in Decision Making

Performance measurement and management began in WSDOT in 1990, when the Washington State legislature mandated a "Programming and Prioritization Study" to evaluate the agency's programming process. Now, performance information is taken into account throughout planning and programming. Comprehensive long-term plans and mode-specific and program-specific plans reference performance measures and performance-based standards. For example:

- The State Bicycle Facilities and Pedestrian Walkways Plan defines its own objectives and performance measures related to each of the six policy goals, recommending that local bike/ped plans also incorporate targets with 2 to 5 year timeframes for achievement.
- The "Target Zero" safety plan prioritizes different strategies based on the prevalence of traffic fatalities associated with several "priority areas" such as impaired driving, speeding, and work zones.

### 16.4 Performance Management in the Organizational Structure and Processes

Performance management is part of the inter-agency culture of Washington State government. The governor meets on a monthly basis with the heads of state agencies and departments to evaluate performance results in the form of an open public forum. Performance information is shared in these forums using the Government Management Accountability and Performance reporting system. Agencies can use these forums to help identify issues, develop performance measures, and report on progress toward reaching strategic goals.

A particular organizational performance management philosophy, called "Lean", is a newly mandated part of Washington State government culture. According to the GMAP website, "Lean is an improvement system and philosophy...[b]ased on the Toyota production system, [which] provides proven principles, methods and tools to develop a culture that encourages employee creativity and problem-solving skills." Washington's Governor, Christine Gregoire, mandated the use of Lean throughout state government through an executive order in December of 2011. The Governor scheduled a "Lean Transformation" conference to explore this change in October 2012. Even before this conference, however, Lean tools such as "Value Stream Mapping" (VSM) have been applied at WSDOT. VSM is defined on the GMAP website as "the activity of developing a high-level visual representation of the process flow involved in delivering a product or service (a "value stream") to customers," and it has been applied to WSDOT's budget process. The value stream map produced by this process identifies tasks that must be completed in the budget process, who is responsible for each task, and when it must be completed. The value stream map illustrates how and when functional units within WSDOT must interact with each other and with functional units elsewhere within state government, such as the Office of Financial Management, in order to complete the annual budget in an efficient manner.

Within WSDOT as well, divisions and offices are mandated to work collaboratively across functional lines, thereby breaking down inefficient barriers and “siloes” within the agency. The Office of Strategic Assessment coordinates performance measurements, systems analysis, strategic planning, and a multitude of state and federal reporting efforts across the agency. As its title implies, the role of this office is strategic in nature; it makes sure that each of WSDOT’s functional units is supporting progress toward policy goals. Day-to-day performance management decisions, on the other hand, are decentralized.

**16.5 Reporting**

WSDOT publishes selected performance results and analysis in a quarterly report called the Gray Notebook (GNB). The GNB is very detailed and begins with a dashboard summary of some key measures Figure 41, shows the target for each measure, its trending direction, and a small comment section for further explanation. Next, each strategic goal is discussed in terms of several selected performance measures. Each measure is described in detail, along with the objectives and strategies the measure is meant to support. Many of these discussions utilize maps, photographs, and innovative data graphics to guide the reader in the analysis (example shown in Figure 42).

	Goal has been met.	Performance is trending in a favorable direction.	Trend is holding.	Performance is trending in an unfavorable direction.		
Policy goal/Performance measure	Previous reporting period	Current reporting period	Goal	Goal met	Progress	Comments
<b>Safety</b>						
Rate of traffic fatalities per 100 million vehicle miles traveled (VMT) statewide (annual measure, calendar years: 2010 & 2011)	0.80	0.80	1.00			The rate of highway fatalities held steady (a lower rate is better). But the total was the lowest since 1954.
Rates of recordable incidents and DART for every 100 WSDOT workers <sup>1</sup> (calendar quarterly measure: Q1/Q2 2011 & YTD 2012)	4.6 3.0	4.3 2.7	—	—		The rate of worker injuries improved; and incidents requiring days away from work improved
<b>Preservation</b>						
Percentage of state highway pavements in fair or better condition (annual measure, calendar years: 2009 & 2010)	93.0%	92.7%	90.0%			Slight reduction from previous year, as Recovery Act projects wrap up
Percentage of state bridges in fair or better condition <sup>7</sup> (annual measure, fiscal years: 2011 & 2012)	95.0%	95.0%	97.0%	—		Deck code ratings criteria continue to be a challenge.
<b>Mobility (Congestion Relief)</b>						
Highways: annual weekday hours of delay statewide at maximum throughput speeds <sup>2</sup> (annual measure: calendar years 2009 & 2011)	28.1 million	32.5 million	N/A	N/A		Increase of 16% from 2009-2011, with 2009 being the least congested year in past five years.
Highways: Average clearance times for major (90+ minute) incidents on 9 key western Washington corridors (calendar quarterly measure: Q1 2012 & Q2 2012)	163 minutes	143 minutes	155 minutes			Average clearance time improved for the quarter, and exceeded the goal
Ferries: Percentage of trips departing on time <sup>3, 7</sup> (quarterly, year to year: Q4 FY2011, Q4 FY2012)	96.2%	95.5%	90%			Performance is less than the same quarter a year ago but still exceeded the goal.
Rail: Percentage of Amtrak Cascades trips arriving on time <sup>4, 7</sup>	67.8%	72.3%	80%	—		WSDOT and Amtrak continue to evaluate projects and other means

Figure 41: Portion of the dashboard summary from WSDOT’s Gray Notebook (June 2012)

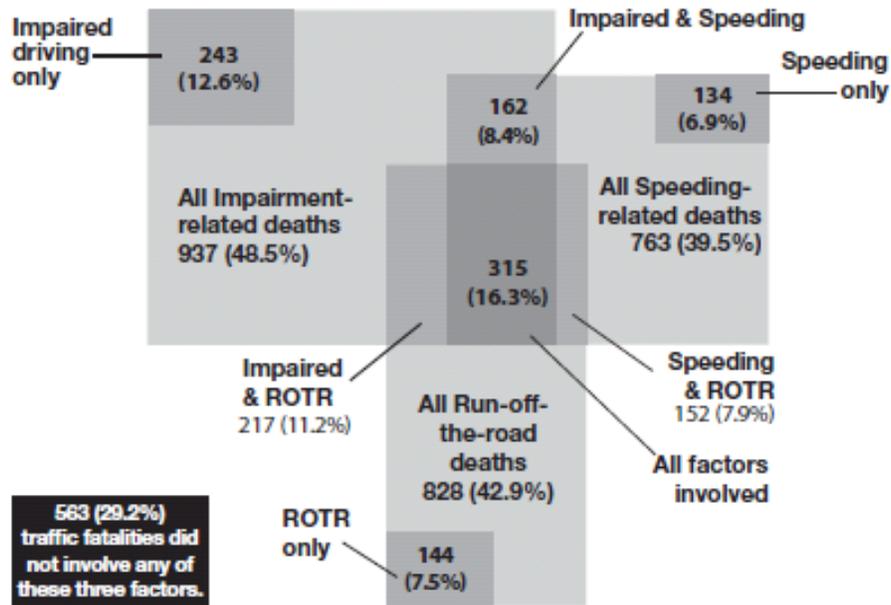


Figure 42: Graphical element from WSDOT's Gray Notebook showing overlapping categories of traffic fatalities (March 2012)

The Gray Notebook (GNB) conforms to what WSDOT calls “performance journalism”; it uses clear, easy-to-understand language, presents data graphically, explains results in concise narratives, and highlights tangible projects and programs that are appealing to the public and other stakeholders. As reported by an FHWA case study:

“Executives at WSDOT credit their performance-reporting techniques, adopted in 2002, with changing public perception of the agency. They used bound quarterly performance reports, distributed to legislators and media members, to demonstrate their ability to efficiently deliver projects and provide a high level of service. Over a five-year period, WSDOT was able to build a credible case to the public for increasing funding. A five-cent gas tax increase was approved in 2003, followed by a nine-cent gas tax increase in 2005.”

Other than the GNB, WSDOT also produces periodic performance reports focused exclusively on traffic congestion, and it contributes to the State of Washington’s GMAP reporting system and the Biennial Transportation Attainment Report produced by Washington State’s Office of Financial Management.

Sources:

- Transportation page on Washington State's Government Management Accountability and Performance (GMAP) website  
<http://www.accountability.wa.gov/reports/transportation/default.asp>
- WSDOT Accountability website, with links to Gray Notebook and other performance-related documents  
<http://www.wsdot.wa.gov/Accountability/default.htm>
- FHWA case study of WSDOT's Performance-based planning process  
[http://www.fhwa.dot.gov/planning/performance\\_based\\_planning/case\\_studies/washington/](http://www.fhwa.dot.gov/planning/performance_based_planning/case_studies/washington/)

\* In addition to publicly available documents, this case study was augmented using information from an interview with WSDOT's Director of Strategic Assessment (April 23, 2012).

‡ This case study has been reviewed by WSDOT's Director of Strategic Assessment.

## 17. New Mexico<sup>o</sup>

### 17.1 Measures Used and Current Framework

As of 2011<sup>1</sup>, New Mexico DOT used 22 performance measures related to asset management, roadway safety, financial efficiency, human resources, transit use, and customer satisfaction. Based on the 2009 report card that NMDOT submitted to the New Mexico Legislature, it appears that each performance measure is associated with one of three programs: the Programs and Infrastructure Program, the Transportation and Highway Operations Program, and the Program Support Program.

### 17.2 Measuring Progress toward Strategic Goals

The New Mexico 2030 Statewide Multimodal Transportation Plan defines the NMDOT mission as “To develop and maintain a transportation system that moves people and goods in a safe, efficient, and environmentally sensitive manner.” To carry out this mission, the agency has identified seven “guiding principles”:

- Multimodal Transportation
- Partnership with Tribal Governments
- Environmental Responsibility
- Partnership with Local Governments
- Safety and Security
- Efficient Use of Public Resources
- Economic Vitality.

The long-range Plan goes on to define multiple “long term planning factors” that are related to these guiding principles; each planning factor is made more specific with agency-wide goals, some of which are in turn made more specific with division-level objectives.

Each goal or objective described in the long-range plan is associated with specific actions to be taken at the agency or division level. For example, the “safety”-oriented planning factor is supported by a goal that “The NMDOT will expand activities designed to reduce the number of impaired drivers on the state’s roads and the number of crashes involving motor vehicles, cyclists, pedestrians and equestrians.” The activities that NMDOT undertakes to improve safety are further described in the agency’s “Comprehensive Transportation Safety Plan (2010 Update)”; the Safety Plan describes twelve “emphasis areas” related to safety, each of which is associated with specific “performance goals” (meaning targets, with specific values and “due dates”), strategies, and measures.

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<sup>1</sup> The performance measures described for NMDOT are reported in the Midwest Transportation Knowledge Network’s 2011 database. They appear to be taken from a 2011 performance report which is no longer available online.

Additional performance measures are defined in accordance with the Stewardship and Oversight Agreement that NMDOT has with the Federal Highway Administration.

### 17.3 Performance Management in the Organizational Structure and Processes

NMDOT includes an office of Strategic Planning and Performance Management, which publishes the agency's quarterly performance report and other deliverables for outside stakeholders such as the state legislature.

As part of its 2012 Stewardship and Oversight Agreement with FHWA, NMDOT has agreed to conduct a joint Program Assessment/Risk Assessment on an annual basis, in order to define needed Program Reviews for the following year.

### 17.4 Reporting

For several years NMDOT published a quarterly performance report called "Good to Great," which received much acclaim through FHWA case studies. By 2012, this report changed names to simply be called "The Quarterly Report." At the time of this study, a current quarterly report was not available from NMDOT.

As part of its 2012 Stewardship and Oversight Agreement with FHWA, NMDOT is working to develop a Performance Indicators Dashboard.

NMDOT provides real-time roadway condition for travelers through NMRoads.com.

### Sources

- NMDOT Main Web Page (accessed September 2012)  
<http://dot.state.nm.us/content/nmdot/en.html>
- Stewardship and Oversight Agreement with FHWA (Accessed October 2012)  
<http://www.fhwa.dot.gov/nmdiv/stewardship/stewardship02.htm>

° This case study incorporates information from correspondence with NMDOT's Strategic Planning and Performance Management office, but it has not been completely reviewed by members of that office.

## 18. Colorado \*†

### 18.1 Measures Used and Current Framework

Colorado DOT (CDOT) tracks more than 350 performance measures, which are relevant to decision making for individual programs of the Department. In its most recent annual performance report, however, CDOT only includes approximately two dozen performance measures according to four investment categories:

- System Quality – Measures are given in report-card style grades for the asset condition of pavements, bridges, roadside facilities, and roadside appearance.
- Mobility – Measures relate to travel delay and snow and ice control.
- Safety – Measures relate to crash rates, injury rates, identified causes of fatal crashes, seatbelt use, and worker safety.
- Program Delivery – Measures relate to on-schedule delivery, work tasks completed, and the participation of disadvantaged business enterprises (DBEs).

For each investment area, CDOT identifies a “primary measure,” which reflects the highest priority in each investment category, and multiple “supporting measures.” In addition to measures categorized by investment area, the 2011 performance report also includes information about customer satisfaction, funding sources, and budgeted investments.

With passage of federal authorization in 2012, CDOT began to move away from its four investment categories and toward national performance areas. Future performance reports will reflect that. The department has also begun to transition from 50-page hard copies of the report to electronic reporting, relying on [YourCDOTDollar.com](http://YourCDOTDollar.com) to quickly depict annual performance to CDOT’s stakeholders.

### 18.2 Measuring Progress toward Strategic Goals

The Colorado Transportation Commission’s Policy Directive 14 identified the four investment categories that are also referred to in quarterly performance reports. The Commission further defined “broad, aspirational, department-wide and long term” goals associated with each investment category. These goals were then translated into financially constrained objectives, that are “measurable, achievable (at adoption), results-oriented, and time-bound.” CDOT’s annual strategic plan associates specific performance measures with each objective. Each performance measure, in turn, is evaluated against a numerical, timebound target, that is expected to be achieved within the term of the annual strategic plan. Some annual targets are associated with federal benchmarks or standards while other targets are set in order to maintain or improve upon forecasted performance.

### 18.3 Using Performance Information in Decision Making

Colorado’s State Measurement for Accountable, Responsive and Transparent (SMART) Government Act requires measures for evaluating performance-based goals be integrated into the State planning and budgeting process. For this reason, Colorado’s

long-term transportation plan states that “Performance measures are part of a performance-based planning and management approach that includes setting clear policies and objectives, tracking performance data and trends, and forecasting to make planning and policy decisions.” Also, CDOT’s FY2013 Budget and Budget Allocation Plan are designed using performance measures.

CDOT acknowledges that some areas of system performance are easier to influence than others:

- System Quality – easiest to influence
- Mobility - harder to influence, except through small transit program that administers grants to local jurisdictions
- One of the most progressive safety programs of any DOTs in the country
- Automated and readily available data

#### 18.4 Performance Management in the Organizational Structure and Processes

Colorado’s Governor-appointed Transportation Commission is responsible for setting CDOT’s agency’s strategic direction, with input provided by staff throughout the agency. This direction is then implemented through annual plans produced by CDOT’s Transportation Development division. The Division of Transportation Development also includes a Transportation Performance Branch, which provides performance measurement and reporting for the agency as a whole. Participation with the Transportation Performance Branch is not mandatory, and not every CDOT division participates. However, the Transportation Performance Branch does help manage more than 300 performance measures, used by divisions throughout the agency, for which it uses an automated data management system. The area where the branch has devoted the most time is in the quarterly and automated reporting of Chief Engineer Objectives.

#### 18.5 Reporting

An annual performance report is published online each year. This report uses traffic lights to visually depict performance results (as shown in Figures 39 and 40).

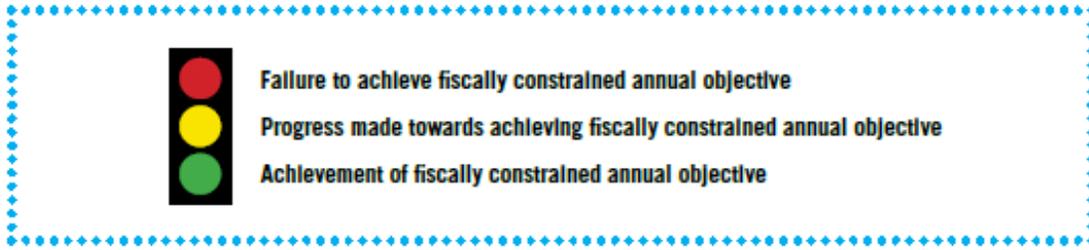


Figure 43: Traffic light-style color coding for CDOT's performance results (from the 2011 Annual Report)

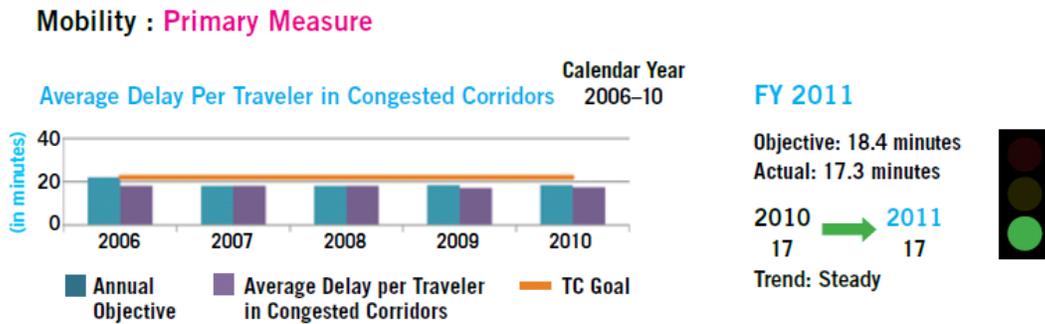


Figure 44: Example entry from CDOT's 2011 Annual Performance Report

In addition to its overall annual performance report, CDOT also prepares or contributes to several other publications that include performance information, such as:

- The Transportation Deficit Report, which quantifies Colorado's transportation budget deficit and estimates the funding levels that would be needed to achieve the Transportation Commission's performance goals and corridor visions over the next ten years;
- Transportation Safety and Traffic Engineering Annual Report;
- Statewide Traffic Records Advisory Committee (STRAC) Report.

Sources

- Main CDOT website: <http://www.coloradodot.info/>
- CDOT's annual reports, including the Strategic Plan, Annual Performance Report, and others: <http://www.coloradodot.info/topcontent/AnnualReports>
- CDOT's Transportation Planning website: <http://www.coloradodot.info/programs/statewide-planning>

\* In addition to publicly available documents, this case study was augmented using information from an interview with CDOT's Performance and Policy Analysis Manager (May 2, 2012).

‡ This case study has been reviewed by CDOT's Performance and Policy Analysis Manager.

# Leading Practices in Organizational and Systems Performance Management in State DOTs

## Volume I: STATE DOT BENCHMARKING STUDY

### Appendix C: EXECUTIVE CHECKLIST

Project Title

**Transportation Asset Management: Organizational Performance and Risk Review**

Submitted to

**Georgia Department of Transportation**  
Angela Alexander, [aalexander@dot.ga.gov](mailto:aalexander@dot.ga.gov)

Organization

**Georgia Institute of Technology**

Principal Investigator

**Adjo Amekudzi, Ph.D.**

Graduate Research Assistant

**Jamie M. Fischer**

**Updated November 15, 2012**

## Performance Management (PM) Executive Checklist

Executive Measures of Success	Agency Evaluation		
	No/?	Some	Yes
Agency actions clearly affect measured performance outcomes			
Measured performance is maintained at acceptable levels or moving in the desired direction			
Important external stakeholders express trust in and satisfaction with agency decisions			
The agency successfully advocates for sustained or additional funding when needed			
Internal stakeholders (managers <u>and</u> technical staff) express confidence in the PM process			
The agency's PM process can adapt to internal and external changes as necessary			
<p><b>If any answers above are "No/Unknown" or "Some," a more in-depth review may be useful. Start with the in-depth check-list below.</b></p>			
Performance Management (PM) Categories and Characteristics	Agency Evaluation		
Selecting Measurement Areas and Designing Measures	No/?	Some	Yes
Measures exist for and are relevant to important agency functions			
Measures exist for and are relevant to strategic goals, objectives, and other agency priorities			
The priorities of key external stakeholders are addressed with performance measures			
Measured values can be affected by agency actions, or they provide important context			
Measures are expressed numerically			
Collecting and Managing Data	No/?	Some	Yes
Measures are supported with data			
Performance data are accurate and consistent			
Performance data are updated regularly, with a reasonable updating period			
Performance data are readily available for analysis across the agency, as needed			
Tracking Achievement	No/?	Some	Yes
Performance values are tracked over time			
Measures have desired directions (trends), which indicate improvement			
Target values are set, as necessary, to guide short-term achievement toward long-term goals			
Target values and timeframes are based on funding projections and technical ability			
When possible, performance is benchmarked against peer agencies and prevailing trends			
Organizational Structure and Processes	No/?	Some	Yes
The agency has dedicated resources and defined champion(s) for PM			
In general, agency employees agree that PM is important			
Measures and targets are regularly reviewed, and adjusted as necessary to meet new needs			
Performance information is used during resource allocation			
Performance information is tracked for and used by functional units throughout the agency			
Different functional units share performance information with each other when necessary, using existing formal mechanisms (horizontal integration)			
Multiple functional units collaborate on performance outcomes, as needed, through formal mechanisms (horizontal integration)			
Reporting & Feedback	No/?	Some	Yes
External stakeholders can access updated performance information easily			
Performance information is made available to the public in multiple ways and is easy to find			
Reporting tools are visually appealing and easy to understand (writing and graphics)			
Reporting tools relate performance outcomes to agency actions			
PM tools and processes are periodically adjusted based on stakeholder feedback			
<p><b>If any of the answers above are "No/Unknown" or "Some," a more in-depth review may be useful. Try the Interactive Self-Diagnostic Tool.</b></p>			

# Leading Practices in Organizational and Systems Performance Management in State DOTs

## Volume I: STATE DOT BENCHMARKING STUDY

### Appendix D: INTERACTIVE SELF-DIAGNOSTIC TOOL

Project Title

Transportation Asset Management: Organizational Performance and Risk Review

Submitted to

**Georgia Department of Transportation**  
Angela Alexander, [aalexander@dot.ga.gov](mailto:aalexander@dot.ga.gov)

Organization

**Georgia Institute of Technology**

Principal Investigator

**Adjo Amekudzi, Ph.D.**

Graduate Research Assistant

**Jamie M. Fischer**

Updated November 15, 2012

The following sections provide a complete view of the Interactive Self-Diagnostic Tool developed for this study. The screenshots shown in Figures 2-14 include information about a fictional agency: Example Department of Transportation (EDOT).

## 19. Cover Page

Screenshots from the cover page of the Self-Diagnostic Tool are provided in Figures 1 and 2.



Figure 1: Screenshots of the Cover Page for the Self-Diagnostic Tool

The cover page familiarizes readers with the purpose of the interactive tool, its organization, and how it operates. Users do not interact with the cover page except to read it and to observe that a comment box appears when the mouse is used to scroll over red flags.

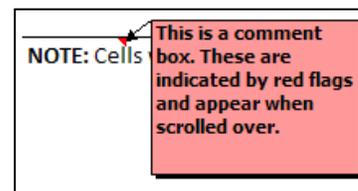


Figure 2: Pop-up comment box on the Cover Page

## 20. User Input A: Agency Context

The first input sheet accepts basic identifying information along with lists of the functional units, goals and objectives, and stakeholders for the organization being analyzed. Most information for this sheet may be gathered from the agency's organizational chart and published strategic planning documents. In this sheet, the user defines the level of depth and detail for the assessment. For example, organizational structure may be defined at the "division" or "bureau" level, or it may list sub-units at the "office" level. Alternatively, the assessment may be conducted for only one division of the agency, in which case it

would necessarily include major “offices” or other sub-units of that division. Other contextual information gathered in this sheet includes strategic goals (and potentially objectives) of the agency, and the agency’s key external stakeholders. Screenshots from Input A are provided in Figures 3, 4 and 5.

**INPUT A - CONTEXT:** This sheet accepts general information about the agency structure, goals and stakeholders, which will inform the remainder of the assessment tool. To use this sheet, please enter your answers in the appropriate colored boxes.

For questions 1- 4, input the appropriate words and phrases into the colored boxes. Note that questions 3 and 4 also require numerical input using the "Check all that Apply Codes." Question 4 can be answered using information from the agency's organizational chart.

**REVIEW DATE:**

1a. Agency Name

1b. Acronym/Alt. Name

1c. Sub-Group (if applicable)

2. Reviewer Name (and/or Title)

**Check all that Apply Codes**

✓ 1 Yes

✗ 0 No

3. Does the agency have a designated office or position to administer or coordinate performance measurement or management across the agency?  
 Check YES or NO  0

If yes, insert office or position title below

Office or Position Name

Accronym/Abbreviation

This assessment tool may be used for the agency as a whole, or for a sub-group of the agency, such as a particular division.

If only one sub-group of the agency is to be assessed, identify it here.

4. What are the organization's major functional units?

List functional units in any order

Show hidden rows to list additional Functional Units

Functional Units		Division	
		Level	Sub-unit
1	(Functional Unit #1)	✓ 1	
2	(Functional Unit #1a)		✓ 1
3	(Functional Unit #1b)		✓ 1
4			
5			
6			
7			
8			
9			
10			

For an agency-wide view, list all functional units at the "division" or "bureau" level.

For more detailed diagnostics, list all important sub-units of the agency or division being assessed.

The functional units listed here will each be addressed with specific questions in later spreadsheets.

For Question 5, list goals and objectives in the cells to the left and use the "Check all that Apply" codes to indicate characteristics of each goal/objective in the cells to the right.

**Figure 3: Questions 1-4 on Input A: Agency Context**

For Question 5, list goals and objectives in the cells to the left and use the "Check all that Apply" codes to indicate characteristics of each goal/objective in the cells to the right.

5a. What are the organization's strategic goals and/or objectives, or other important decision making areas? (Mark as goal or objective if applicable)  
 5b. Are these important decision making areas defined explicitly in internal and/or external agency documents (such as the mission, vision, strategic plan, internal process documents or other documents)? (Check "explicit in agency documents" where applicable)  
 5c. Are any of these decision making areas of higher priority than the others? (Check "high priority" where applicable)

List goals in any order. Follow each goal with any related objectives (if applicable) before moving on to the next goal. Indicate in the boxes at right whether an entry is a strategic goal or objective, if it is explicit in agency documents, and also if it has high priority.

Show hidden rows to list additional goals and/or objectives if necessary.

	Text of the goal, objective, or other decision making area	Strategic Goal (5a)	Related Objective (5a)	Explicit in Agency Documents (5b)		High Priority (5c)
1	{Goal Area #1}	✓ 1		✓ 1	✓ 1	
2	{Objective Area #1a}		✓ 1	✗ 0		
3	{Goal Area #2}	✓ 1		✓ 1	✓ 1	
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Figure 4: Question 5(a-c) on Input A: Agency Context

For questions 6 and 7, consider the entire process of performance management at the organization and the external stakeholders and partners involved. For question 7a, input the names of the important stakeholder groups and mark whether or not these are listed in order of priority. For questions 7b-7c use the 'Check all that Apply' codes in the appropriate colored boxes.

	Complete External Control	Considerable External Influence	Minor External Influence	the organization is Autonomous
6. To what extent are the organization's performance management procedures defined externally?		✓ 1		

7a. Who are the key (external) stakeholders or stakeholder groups for the performance management program? (Input names in list)

7b. Do these stakeholders need or want access to performance information? (Check all that apply)

7c. Is the cooperation or input of these stakeholder groups necessary for to effectively carry out its responsibilities? (Check all that apply)

List stakeholders in any order

Show hidden rows to list additional stakeholders

	(7a) External Stakeholder or Group Name		7b	7c
			Stakeholder Wants Information	Needs Stakeholder's Input or Cooperation
1	{Stakeholder #1}		✓ 1	✓ 1
2	-			
3	-			
4	-			
5	-			

Figure 5: Questions 6 and 7(A-C) on Input A: Agency Context

Once the agency context is set in Input A, the following three worksheets ask detailed questions about performance measures and targets and organizational processes. The

questions in Inputs B-D relate to the characteristics of performance management indicated in the maturity model developed for this study.

## 21. User Input B: Performance Measurement

The second input sheet accepts information about how the organization's performance measures and targets address "important areas of decision making," including the agency's strategic goals and objectives, and any other areas that the user specifies. The sheet also asks about whether strategic goals, objectives, and performance targets reflect the priorities and preferences of key stakeholder groups. For Input B, answers are given with numerical answer codes shown in Figure 6. Screenshots from Input B are shown in Figures 7 and 8.

<u>Ordinal Answer Codes for Yes/No Questions</u>		
● 3	Yes/All Measures/Very Much so	
● 2	To some extent/Sometimes/Somewhat	
● 1	No/Not at all	
● 0	Unknown	

Figure 6: Ordinal answer codes used in the Interactive Self-Diagnostic Tool

In Input B, the sheet accepts information about the agency's suite of performance measures and targets. The user should answer questions 1-13 for each decision-making area (i.e., goals and objectives automatically copied from Input A), take note of any problem areas for which performance measurement practices are not fully developed, and identify actions for enhancing performance measures and targets in these areas.

**INPUT B - PERFORMANCE MEASUREMENT:** This sheet includes questions related to the suite of performance measures and targets used by this organization. Input answers to each question in the information given in the previous sheet (Input A - Agency Context). Then develop action notes based on observed findings.

For each of the areas of decision making listed below (explicit and unexplicit goals and objectives copied from Input A), answer questions 1-11 by entering the appropriate "Ordinal Answer Codes for Yes /No Questions" in the appropriate colored boxes. (NOTE: Answer questions in order for each decision-making area. If a cell turns gray, it should be skipped.)

		Ordinal Answer Codes for Yes/No Questions											
		3	Yes/All Measures/Very Much so										
		2	To some extent/Sometimes/Somewhat										
		1	No/Not at all										
		0	Unknown										

- Which of the organization's functional units has primary responsibility for achieving this goal area (who is the identified performance champion)?
- Does the organization have performance measures associated with this important area of decision making?
- Are performance measures in this area formulated such that changes can be tracked numerically?
- Do performance measures in this area give actionable information? For example, are they explicitly linked to actions or strategies that has taken and/or can take?
- Whether or not performance measures exist, does already collect data related to this important area of decision making?
- Is the organization confident that the existing data are sufficiently accurate?
- Given existing funding projections, can the organization afford to sustain regular data collection in this area indefinitely? (Are the data affordable?)
- Is maximizing its existing data resources for performance measurement in this area?
- Is it clear whether each measure should be increasing, decreasing, or maintaining at or near a particular threshold? (Desired trend directions)
- Are performance targets set to guide short term achievement?
- Has defined timeframes for achieving its targets?
- Based on current projections, are currently defined targets achievable (within their defined timeframes)?

	1	2	3	4	5	6	7	8	9	10	11	12
	Identified Performance Champion (dropdown)	Measures Exist	Measures are Numerical	Measures are Actionable	Data Exist	Data are Accurate	Data are Affordable	Existing Data are Maximized	Desired Trends are Clear	Target Values are Established	Timelines are Defined for Achievement	Targets are Achievable
Strategic Goals/Objectives (From Input A)												
Goal (Goal Area #1)	Executive Management											
Objective (Objective Area #1a)	(Functional Unit #1)											
Goal (Goal Area #2)	No primary champion (agency-wide goal)											
-												
-												

**Figure 7: Questions 1-12 and the associated input table (partially filled in) from Input B: Performance Measurement**

Following question 12, Input B includes one more question. Question 13 asks whether or not the agency uses additional performance measures that are not associated with the strategic goals and objectives addressed in questions 1-12.

**22. User Input C: Organizational Processes**

This sheet accepts information about how different parts of an agency use and interact with performance measurement information. The user should answer 14 questions for each functional unit (automatically copied from Input A), take note of any unit(s) that are not participating in performance management in a manner that helps them achieve relevant goals and targets, and identify actions for enhancing organizational processes. Screenshots from Input C are shown in Figures 8 and 9.

**INPUT C - ORGANIZATIONAL PROCESSES:** This sheet includes questions about agency procedures and inputs related to performance management, who reviews performance information within the agency, how is integrated across different levels of decision making and functional units within the agency structure. Input answer codes to each question in the associated colored boxes. Then develop action notes b

**Organizational Structure, Policies, and Procedures:** Answer Questions 1-4 using the "Check All that Apply" Codes.

1. How often, on average, are the organization's strategic goals/objectives, related performance measures, and targets, reviewed for potential revision?

	Goals and Objectives	Performance Measures	Performance Targets
With the Strategic Plan Update			
Annually			
Quarterly			
Another frequency (describe)			
They have never been revised			

Check all that Apply Codes

✓ 1 Yes  
✗ 0 No

Describe other frequency below (if applicable)

---

2a. What existing processes support the organization to revise its performance management structure and procedures, as needed, in order to address new contexts or needs?

Check all that apply	Periodic Executive Review	Periodic Surveys of Staff	Occasional Suggestions	Another Process	No Process Exists	(Describe other process below, if applicable)

2b. Do the organization's periodic surveys of staff explicitly ask about employee satisfaction?

---

3. (Vertical Integration) How does the organization ensure that performance information and relevant decisions are shared effectively across its organizational hierarchy?

Check all that apply	Regular in-person meetings	Regular internal reports	Shared Database(s) or Dashboards	Another Process	No Process Exists	(Describe other process below, if applicable)

---

4. (Horizontal Integration) How does the organization ensure that performance information is shared, as necessary, across and among its functional units?

Check all that apply	Regular in-person meetings	Regular internal reports	Shared Database(s)	Another Process	No Process Exists	(Describe other process below, if applicable)

Figure 8: Screenshot of Input C showing Question 1 - 4

**Performance-Related Responsibilities and Outcomes:** Answer questions 5-14 below for each of the given groups (locations within the organizational hierarchy and functional units as defined in Input A) by using the "Answer Codes for Yes/No Questions." Note that questions 11 and 14 may be answered with alternative codes (see pop-ups).

5. Does the staff in this group understand and value the concept of performance management?  
 6. Does this group help define 's strategic goals and/or objectives?  
 7. Does this group help define performance measures and/or targets that are reported to external stakeholders?  
 8. Does this group define performance measures and/or targets that are for internal use only (that is, NOT reported to external stakeholders)?  
 9. Does this group collect data inputs for performance measurement?  
 10. Does this group perform analysis using performance information?  
 11. Does this group use performance information to make decisions on a regular basis?  
 12. Does this group require information from any of the organization's other groups in order to perform its functions?  
 13. In this group, is up-to-date performance information readily available to those who need it, when they need it?  
 14. Overall, or on average, has this group demonstrated desirable performance outcomes over the last 1 to 3 years?

Ordinal Answer Codes for Yes/No Questions

● 3 Yes/All Measures/Very Much so  
 ● 2 To some extent/Sometimes/Somewhat  
 ● 1 No/Not at all  
 ● 0 Unknown

	5	6	7	8	9	10	11	12	13	14
Functional Unit or other group within Agency	Values Performance Management	Helps to Define Strategic Goals/Objectives	Defines Externally Reported Measures and Targets	Defines Measures and Targets for Internal-Only Use	Collects Data	Performs Analysis	Regularly Makes Performance-based Decisions	Needs Outside Information	Receives Timely Information	Typically Demonstrates Desirable Outcomes
Top Management										
Mid-level Management										
"Front-Lines" Employees										
(Functional Unit #1)										
(Functional Unit #1a)										
(Functional Unit #1b)										
-										
5										
-										
-										
-										
-										
10										

Figure 9: Screenshot of Input C showing questions 5-1

### 23. User Input D: Stakeholder Relations

This sheet accepts information about the agency’s performance reporting and feedback mechanisms that collect information from (and about) external stakeholders. The user should answer questions 1-4 for each external identified stakeholder group (automatically copied from Input A), take note of any problem area(s) where stakeholder and/or agency needs are not being met by existing engagement and reporting processes, and identify actions for enhancing stakeholder engagement. Screenshots are shown in Figures 10 and 11.

INPUT D - PERFORMANCE REPORTING AND FEEDBACK: This sheet includes questions about how performance information is reported to stakeholders, and how feedback is collected from stakeholder opinions. Ext information given in Input A - Agency Context. Provide answer codes for each question, and each stakeholder, in the appropriated colored boxes. Then develop action notes based on observed findings.

For Questions 1-3, use the "check all that apply codes" to indicate which of the given options reflect agency practice. Give answers for each stakeholder/group as distinct from other stakeholders/groups. If a particular agency practice is not reflected in the options available, use the available space for "another" option to describe actual agency practice in words.

1. REPORTING FREQUENCY: How often does the organization formally provide updated performance information to each stakeholder/group?

Check all that apply	With the Strategic Plan Update	At Least Annually	At least Quarterly	At least Monthly	Continually/ Every Day	Another Frequency	Never	(Describe other frequency below, if applicable)
(Stakeholder #1)								
-								
-								
-								
-								
-								

User may show hidden rows for additional stakeholders

2. REPORTING METHODS: Which methods does the organization use for reporting performance information (specifically) to each stakeholder/group?

Check all that apply	Report Documents	Website(s)	Dashboard Graphics	Time Series Charts	News Media	Social Media	In-Person Meetings	Another Method	Describe Other Method If Applicable
(Stakeholder #1)									
-									
-									
-									
-									
-									

Show hidden rows above for additional stakeholders

Figure 8: Screenshot of Input D showing questions 1 and 2 with the associated answer cells

3. STAKEHOLDER INPUT: What mechanism(s) does the organization have in place to get feedback from and learn about each stakeholder/group? (Answer for each particular stakeholder/group, as distinct from other groups)

(Check All that Apply)	Measure of use	Detailed Survey/Poll	Emails/ Calls	Social Media	In-person meetings	Another Method	None	Describe Other Method If Applicable
(Stakeholder #1)								
-								
-								
-								
-								

Show hidden rows above for additional stakeholders

3b. Which subjects are included on the organization's stakeholder surveys?

(Check all that apply)	Stakeholder Satisfaction in General	Satisfaction with Specific Elements	Stakeholder Priorities or Preferences	Quality of Reporting	Uses of Performance Information	Other Subjects	Describe Other Important Subjects
(Stakeholder #1)							
-							
-							
-							
-							

For Question 4, use the "ordinal answer codes for yes/no questions".

4. STAKEHOLDER SATISFACTION: According to existing feedback, to what extent do each of the following reflect the needs and priorities of each stakeholder/group? (In other words, how satisfied is each stakeholder/group with each of the following?)

- (a) the organization's strategic goals and objectives
- (b) the organization's definition of desirable performance trends and targets
- (c) The effectiveness of the organization's performance reports
- (d) the organization's demonstrated performance, in general (recent achievement record)

Ordinal Answer Codes for Yes/No Questions

3	Yes/All Measures/Very Much so
2	To some extent/Sometimes/Somewhat
1	No/Not at all
0	Unknown

Figure 9: Screenshot of Input D showing questions 3 and 4

## 24. Gap Identification and Development of Recommendations

The user can review the inputted information to identify gaps and develop recommendations for moving the agency's performance management program to the next level, based on user inputs.

# **Leading Practices in Organizational and Transportation Systems Performance Management**

## **Volume II: Value Tradeoff Analysis Study**

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**Draft Final Report  
November 15, 2012**

## Table of Contents

Executive Summary .....	E3
1. Introduction .....	E4
1.1 Study Objectives and Outline .....	E4
2. Literature Review Synthesis.....	E4
2.1 Types of Analytical Tools .....	E5
2.2 Multi-Objective Optimization.....	E7
2.3 Principles of Multi-Objective Optimization .....	E7
3. Approaches to Determine Solution.....	E8
3.1 Multi-Objective Linear Programming .....	E8
3.2 Preemptive Optimization .....	E9
3.3 Weighted-Sum Method .....	E9
3.4 Goal-Programming Method.....	E9
4. Overview of Conducted Survey.....	E10
4.1 Synthesis of Survey Results.....	E10
5. Moving Forward: GDOT .....	E12
5.1 The Computerized Pavement Condition Evaluation System (COPACES) .....	E13
5.2 The Bridge Information Management System (BIMS).....	E13
5.3 Highway Safety Management System .....	E13
6. Requirement Assessment for Integrated System to Assess Tradeoff .....	E13
7. Potential Applicability of Network-level Value Tradeoff at GDOT .....	E14
7.1 Visualized Illustration .....	E14
8. Conclusions.....	E15
References .....	E16

## Executive Summary

Value tradeoff analysis is important to make values more explicit in decision making, and identify the opportunity costs of allocating resources to achieve different program objectives across different asset classes. This report examines the use of value tradeoff analysis tools for cross-asset investment decision making to achieve network-level performance among State Department Transportation. First, a literature review was conducted to identify agencies performing cross-asset value tradeoff analysis. Second, we conducted a survey to identify agencies applying tradeoff analysis in their asset management programs to determine the underlying methodologies being used for tradeoff analysis, and how they are integrated with other elements of the agencies' asset management systems. Finally, the report offers recommendations on how to harness the current Asset Management capabilities at Georgia Department of Transportation (GDOT) to support cross-asset value tradeoff analysis.

As part of the survey, we contacted all 50 state Departments of Transportation and Washington, D.C. Out of the agencies contacted, 21 responded (41% response rate). The results of the survey indicate that the current state of the practice includes a wide range of approaches that are either performed explicitly using computational approaches or implicitly use inputs from experts, or a combination of both. Out of the responding agencies, five responded that they conduct some sort of network-level value tradeoff analysis across assets or program objectives. However, only three of these agencies responding in the affirmative were using explicit analytical approaches. The remaining two were using informal procedures to assess tradeoffs. These results show limited but growing use of value tradeoff analysis in resource allocation. In addition to the five agencies, which responded in the affirmative to conducting cross-asset value-tradeoff analysis, two other agencies also responded that they have purchased off-the-shelf network-level cross-asset value-tradeoff analytical tools which are still in the validation stages for future use.

The report recommends a goal-programming strategy to harness GDOT's present capabilities in Transportation Asset Management to conduct value tradeoff analysis.

## **1. Introduction**

Value tradeoff analysis involves measuring the value of a forgone or a compromised alternative in a situation of conflicting objectives. In other words, how much of benefit do you gain or lose, for an investment you make in one alternative out of a broad set of different investment options? Usually, transportation investment decision making involves multiple objectives, some of which conflict or compete with each other. Therefore, optimizing an agency's investment becomes a challenge. However, systems analysts or asset managers can optimize their decision making by generating efficient frontiers, that is, by simulating a series of efficient decision points to guide them in performing cross-asset value tradeoff analysis, which can in turn improve the quality of their decision making. Value tradeoff analysis is important to help agencies understand the opportunity costs of various investment alternatives and in so doing to make more informed decisions. Such analytic capabilities may be developed to enhance existing asset management programs where investment analysis is conducted without including multiple objective or cross-asset considerations.

### 1.1 Study Objectives and Outline

This study addresses the following questions: what value tradeoff analysis tools exist, what analytical approaches are being used in such tools, and how best can GDOT's present capabilities be harnessed to develop value tradeoff analysis capabilities based on agency strategic objectives? More specifically, this study accomplishes the following:

- Reviews the use of value tradeoff analysis tools for decision support in state Departments of Transportation (DOTs);
- Evaluates the applicability of methodologies in the GDOT context;
- Assesses requirements for an integrated system to assess tradeoffs among investments to accomplish preservation, mobility, and safety objectives;
- Makes recommendations for using the existing GDOT infrastructure management systems to conduct tradeoff analysis in investments for preservation, mobility, and safety

The remainder of the report is organized as follows: the first section presents a literature review synthesis which depicts how multi-objective optimization and value tradeoff analysis are conducted in investment decision making. The second section presents the results of a survey on the use of value tradeoff analysis in state DOTs and one notable case study. The third and last section makes recommendations on how the present asset management capabilities at GDOT can be harnessed to conduct value tradeoff analysis.

## **2. Literature Review Synthesis**

As performance measurement and management activities have developed in agencies, so the idea of value tradeoffs in decision making has gained attention. While few practical applications exist in Transportation Asset Management and in state DOTs in particular,

the literature shows extensive use of value tradeoff analysis in Operations Research. Figure 1 illustrates typical processes of performing value tradeoff analysis.

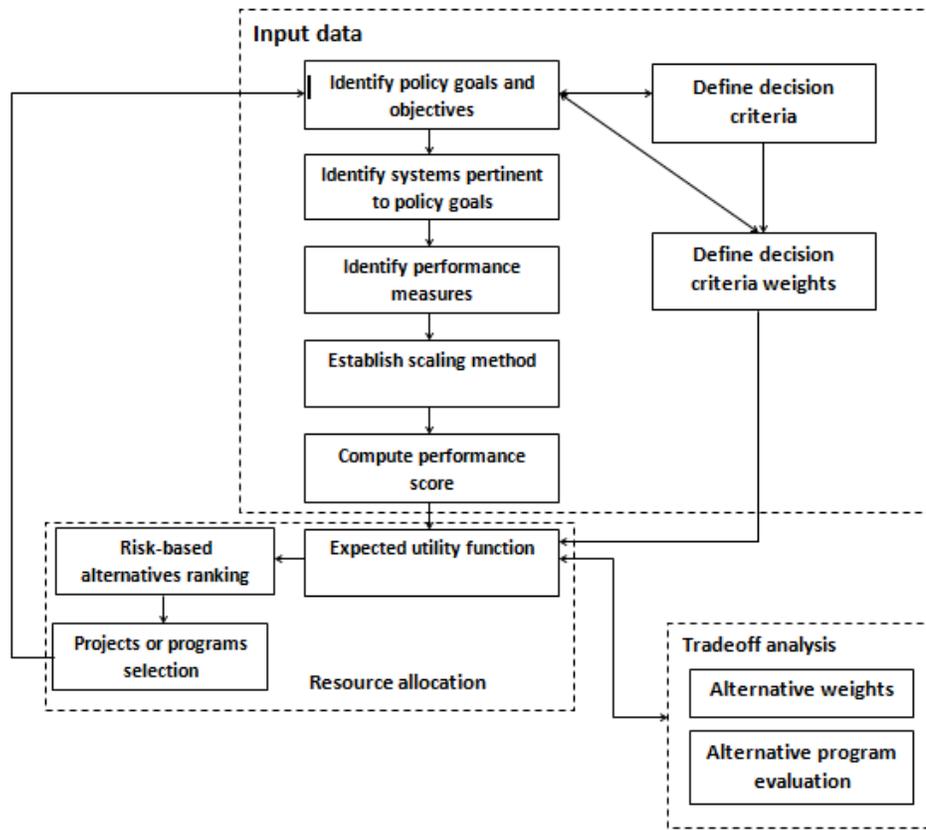


Figure 1: Value Tradeoff Analysis Framework

### 3.

#### 2.1 Types of Analytical Tools

Documented in NCHRP 545, the study “Analytical Tools for Asset Management” was one of the earlier ones undertaken on value tradeoff analysis (Cambridge Systematics et al., 2005). This study conducted a needs assessment and proposed tools that could improve resource allocation. The study objectives were to provide new analytical tools and emphasize the need for tools that help agencies make difficult tradeoff decisions for resource allocation, while considering asset preservation concerns and taking into account the other broader set of policy objectives (e.g., mobility, safety, and economic development). The reason for this consideration is that these objectives give rise to essential performance measures that can be incorporated in investment decision making for transportation assets. The study recognizes the great value provided by existing analytical tools and also identifies the gaps in their capabilities. The study emphasizes the need to address these gaps to improve the quality of transportation investment decision making. Finally, the study designs, prototypes, tests, and refines two tools—the

Asset Manager NT and the Asset Manager PT—which are capable of performing value tradeoff analysis in resource allocation.

AssetManager NT has the capability of integrating results from multiple management systems such as the Federal Highway Administration (FHWA) Highway Economics Requirements System (HERS), pavement and bridge management systems to facilitate what-if analysis. The end user can configure what data to import, what measures to display, and how funds are distributed (e.g., by district, region, or other groupings). The system can then display, for a given overall budget and allocation among assets, the predicted performance of the system over time. According to the literature, a number of agencies, including NJDOT, use either AssetManager, or perform similar analyses through manual or spreadsheet approaches (Cambridge Systematics Inc., et al., 2009).

The literature review also indicates that Utah DOT conducts a high-level resource allocation between their pavement and bridge investment needs using the Deighton dTIMS system on the basis of remaining service life, with adjustment based on various factors (Cambridge Systematics Inc., et al., 2009). Using this system, Utah DOT has successfully performed cross-asset analysis for multiple assets including pavement, structures, safety, mobility, and maintenance needs. Utah DOT allocates funds between pavement and bridges on the basis of remaining service life, with adjustments based on a variety of factors.

Another study that proposes a decision-support tool for value tradeoff analysis is a risk-based methodology that estimates the benefits and the costs of highway safety hardware projects for highway segments and intersections (Li & Madanu, 2008). Although this methodology focuses only on one program area—safety— of a transportation agency, the basic idea can be very much transferred to other program areas of the agency. In this study, the author uses the difference in the current-case safety index (without safety hardware improvement) and the base-case safety index with safety hardware improvement, which is regarded as the potential for safety improvements (PSIs) as a result of safety implementation. The author subsequently computes the annual potential for safety improvement using the concept of consumer surplus. These annual potential safety gains resulting from the implementation of the safety project are then converted to dollar values. By extrapolating, these gains are transformed into a life-cycle potential gain/benefit. Similarly, the corresponding life-cycle costs are computed. Consequently, by transforming these values into their net present worth, a benefit-to-cost ratio approach can be used as a basis for project tradeoff. Finally, the author validates the methodology by introducing statistical tests to compare empirical Bayesian crash estimates and PSIs. This methodology can be replicated at the network level by incorporating other programs within an agency.

Qai et al. (2008) developed some techniques for carrying out multiple-criteria project selection and tradeoff analysis among the different management systems that are collectively used for highway asset management. The authors' methodology is based on multi-objective optimization problem solving. The framework is formulated such that it can adopt any one of the several statistical measures of performance for a network, for the purpose of optimizing the decision maker's choice or performing a value tradeoff

analysis. In conducting a value tradeoff analysis, they applied genetic algorithm techniques to generate an efficient Pareto frontier for the multi-objective optimization problem. This efficient frontier enables the decision maker to visualize the performance of each investment portfolio as compared with the recommended efficient scenarios. They finally used numerical examples to simulate a number of tradeoff contexts—tradeoffs among projects, tradeoffs among performance measures, tradeoffs across various performance measures at different budget levels; tradeoffs between overall project benefits and risk, and tradeoffs between budgetary levels of the different sub-areas or management systems.

2.2 Multi-Objective Optimization

Traditionally, majority of asset management analytical tools focus on one decision criterion, for example, lifecycle cost or net benefit. However, in transportation asset management, asset managers or DOTs are challenged with not just reducing the lifecycle costs or optimizing the benefits of their physical assets, but are also presented with other decision criteria such as reducing congestion, improving safety, or improving preservation, which may sometimes require compromises. In general, some of these objectives will be in conflict with others, and some will have to be reduced while others are being increased. Therefore, finding a solution set that optimizes the problem becomes challenging. Consequently, systems analysts seek for strategies to provide solutions to the problem. In addressing these issues, Patidar et al., in their work developed network- and bridge-level methodologies that involve multiple performance criteria and also involve selection of investment choices based on optimization (2007). This methodology is a typical example of multi-criteria decision making in transportation investment. In addition to these multiple criteria, the problem is exacerbated by other complex sets of constraints such as budget constraints. Budget constraints occur where, for example, some Federal funds can only be used for a particular program area.

2.3 Principles of Multi-Objective Optimization

Systems analysts can solve the scenario stated above using the principles of multi-objective optimization. Consider, for an example, that a DOT with  $k$  objectives and  $n$  decision variables, to be maximized, is seeking a solution to such a problem. In this scenario, the decision space  $X$  will contain the solution, which is called the decision vector, represented as  $(X_1, X_2, X_3, \dots, X_n)$  to this problem.

In general, this multi-objective optimization problem is defined as follows:

$$\text{Maximize } \{f_1(x), \dots, f_k(x)\}$$

$$\text{Subject to } x \in S, \text{ and } S \subset R^n$$

where  $S$  and  $R^n$  are the decision space and objective space, respectively.

Subsequently, an objective vector can be denoted by  $f(x) = (f_1(x), f_2(x), \dots, f_k(x))^T$ .

In this problem, in order to obtain the optimal solution, the transportation agency has to maximize every criterion. Although this is the ideal situation, in reality, this situation is usually not achievable. Therefore, the question is how does the decision maker obtain an optimal (or the best possible) solution? To obtain an optimal solution, systems analysts can use the principles of Pareto-optimality or non-dominated solutions. That is, first, the analyst can generate a series of non-dominated, efficient, or Pareto fronts from which tradeoff analysis is performed to select the optimal solution. The non-dominated set of solutions is defined as the set for which no other feasible solution is at least as good for every objective and strictly better in one. That is, for a decision vector  $x^* \in S$ , if there is no other decision vector  $x^- \in S$  such that  $f_i(x^-) \leq f_i(x^*)$  for at least one index  $j$  and all  $i = 1, \dots, k$  and  $f_j(x^-) < f_j(x^*)$ , then,  $x^*$  is called the non-dominated set or Pareto-optimal.

For example, consider a transportation agency with two objectives, with discrete set of points within the objective space as  $\{[1, 2], [1, 3], [3, 1]\}$ . In this simulation, the decision maker can confidently select the non-dominated solution sets—  $[3,1]$  and  $[1,3]$  — as his/her efficient Pareto front, i.e., assuming, for each objective, more is better. This solution, therefore, represents the ideal objective vector. In addition, decision makers also can define a nadir objective vector  $z^{\text{nad}}$  that lies within the solution space. This helps decision makers to set lower and upper bounds representing the ideal and the nadir objective vectors, respectively, for tradeoff evaluation. In other words, there may exist several optimal objective vectors representing different tradeoffs between the objectives. Indeed, knowledge about these vectors can help the decision maker to select the best compromise solution.

Practically, from computational analysis of the solutions, each solution represents an equally good compromise since there is no mathematical tool to find the best solution in the Pareto-optimal front. As a result of this gap, decision makers can make use of experts' knowledge to find the most satisfying solution. In addition to the inputs from experts, the decision maker can also consider other relating factors that go into decision making such as political influences, environmental issues, or any other information that aids the decision maker in decision making. In fact, decision makers should understand that the purpose of this tool is not to spill out a single solution that happens to be the optimal solution, but is to aid them in the decision making process of finding the most superior solutions and understanding the tradeoffs amongst them.

## 4. Approaches to Determine Solution

In general, multi-objective optimization problems can be solved using different approaches. Although these approaches are devised to be different and are executed using mathematical or simulation approaches, they all concentrate on finding a Pareto set. The literature offers a number of strategies, some of which are expounded here. In addition, appendix A illustrates how other researchers have approached and solved the objective problem.

### 3.1 Multi-Objective Linear Programming

One of these strategies is multi-objective linear programming (MOLP). In MOLP, we assume that both the objectives and constraints are linear. The MOLP is widely used and very important in economics problem solving. This strategy relies on a structured algorithm to identify the entire efficient frontier. However, when the objective problem becomes large, this approach becomes computationally difficult. Moreover, once the efficient frontier is found, there is still the need for some method to select a final solution from the set of infinite efficient sets.

3.2 Preemptive Optimization

Another strategy that analysts can adopt to solve the multi objective problem is preemptive optimization. In this approach, based on priorities, the analyst first optimizes the higher-priority objective. Once a solution is obtained for this objective, the analyst then moves on to optimize the next objective, treating the first obtained solution as a constraint. That is, the optimal objective value is considered as a bound. The analyst continues until he/she considers all the objectives. The result of this iteration yields a final solution that represents the efficient point of the original multi-objective problem.

3.3 Weighted-Sum Method

The weighted sum method is another approach for analyzing value tradeoffs. In using this approach, the analyst converts multiple objectives into one single objective function using weights and summation. First, the decision maker determines the importance of each objective and assigns appropriate weights to them. Second, he/she selects a measure of performance for each objective, and finally sums them up as illustrated by equation 1 (Neumann et al. 1997). An optimal solution to the objective problem is represented as an efficient point within the solution space.

$$U_{A_i} = \sum_{j=1}^n w_j a_{ij} \quad i = 1, 2, \dots, m \dots \dots \dots \text{Equation 1}$$

Where  $U_{A_i}$  = Expected utility for asset/program  $A_i$

$w_j$  = weight of performance measure  $j$

$a_{ij}$  = scaled value of performance measure  $j$  for alternative  $i$

$n$  and  $m$  are the number of performance measures and alternatives, respectively.

3.4 Goal-Programming Method

The goal-programming method is the last but not least of these solution seeking approaches reviewed in this study. With this method, instead of decision makers seeking to maximize or minimize an objective, they rather strive to achieve target levels. One of the advantages of using this method is that it is easier to implement (Keeney et al., 1993). As an example, consider having  $k$  objectives that result in  $k$  goals. That is, the goal of the first objective,  $O_1$ , is  $g_1$ , and so on. Then,  $O_1 > g_1, O_2 > g_2, \dots, O_k > g_k$ . These goals are treated as soft constraints. That is, although they act as constraints, the feasible solutions

for the problem can violate these constraints. With these precepts in mind, the analyst then measures the deviation of each objective from the target goal (Keeney et al., 1993). In essence, the absolute magnitude of each deviation is the interest of the decision maker. However, the solution set of this problem is not necessarily an efficient front of the objective problem.

## 5. Overview of Conducted Survey

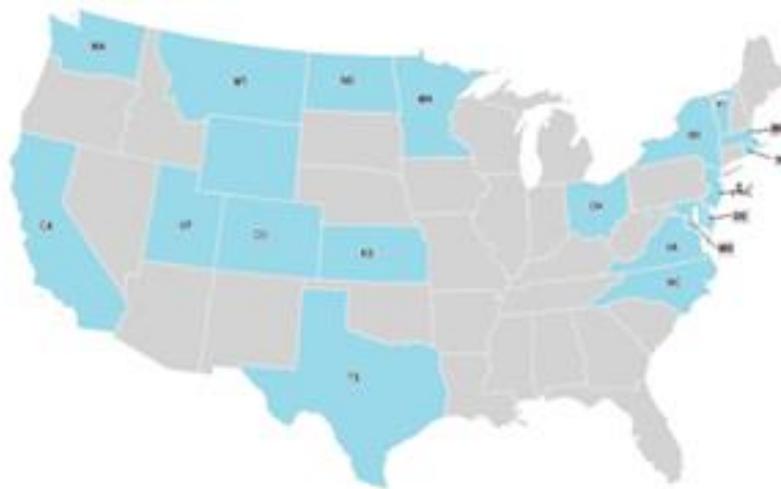
As part of this study, we conducted a survey to verify the state-of-practice as well as identify some best practices. In the survey, we asked four basic questions;

- Does your agency conduct cross-asset/program value tradeoff analysis?
- If so, what assets/programs are involved?
- How is this tradeoff analysis performed?
- What are the analytical procedures involved?

During the period of October 2011 and March 2012, we contacted all the 50 state DOTs and the District of Columbia. The following section synthesizes the results of the survey.

### 4.1 Synthesis of Survey Results

There were 21 responses to the survey (41% response rate). Figure 2 shows the responding agencies. Of the responding agencies, five indicated that they perform some sort of network-level value tradeoff analysis across assets or program objectives. However, only three of these agencies responding “YES” indicated that they do so using explicit analytical approaches. The remaining two use informal procedures to conduct tradeoff analysis. These results show limited use but growing interest in the use of value tradeoff analysis in resource allocation. In addition to these five agencies, two other agencies also responded that they have purchased off-the-shelf network-level cross-asset value-tradeoff analytical tools which were still in the validation stage for future use.



**Figure 2: Agencies Responding to Survey**

Although this survey only focused on state DOTs, and Washington, D.C., some of the information gathered from some of the responding state DOTs indicated that even though they are not performing cross-asset value tradeoff analysis, at the district level, some offices actually perform value-tradeoff analysis across their different program areas. This is because the district offices have greater autonomy over their budget. Most of these offices were using engineering judgment instead of using an explicit analytical approach in performing the tradeoff analysis.

Another concern responding agencies emphasized related to establishing a common measure that can be used to evaluate the tradeoffs, such as the ability to compare the benefits of saving three lives to the benefits of reducing travel time by say 30%. Agencies also expressed the inability to capture safety benefits from performing an action, e.g., resurfacing, on a pavement segment.

Although they are not currently using it, one agency reported that they implemented a prototype network-level cross-program value tradeoff analysis tool as far back as 2002. The focused program areas and assets for the analysis are pavements, bridges, safety, and mobility. These program areas were selected because the agency already had related systems in place using asset management principles. The approach is to evaluate and measure (using a common unit) how an intervention in any of these program areas or assets contributes to reducing user costs over a link. For example, for a given link, an economic analysis between a pavement and a bridge project may be conducted to identify the projects/programs that perform best in reducing user cost.

Next, tradeoff analysis is conducted by calculating the resultant excess user cost, defined as incremental costs incurred by users of a facility attributed to less than ideal operating conditions, for each of the 7,000 analysis links within the 15,000-centerline-mile of the State highway system (Shufon & Adams, 2003). Excess user cost consists of costs of delaying travelers and freight, accident costs, and vehicle-operating costs (Shufon & Adams, 2003). Equation 2 is used in calculating the total excess user cost (TEUC) for each analysis link.

$$TEUC_l = \sum_{i \in l} EUC_{p_i} + \sum_{j \in l} EUC_{b_j} + \sum_{k \in l} EUC_{s_k} + \sum_{n \in l} EUC_{m_n} \dots \dots \dots \text{equation 2}$$

Where

$EUC_{p_i}$  = Excess user cost for pavement segment  $i$   $EUC_{b_j}$  =

$EUC_{b_j}$  = Excess user cost for bridge  $j$

$EUC_{s_k}$  = Excess user cost for safety – deficient location  $k$

$EUC_{m_n}$  = Excess user cost for mobility – deficient location  $n$

$\in l = \text{belonging to analysis link } l$

Since the links make up corridors, consequently, each TEUC is aggregated, as illustrated by Equation 4, to find the excess user cost for each corridor within the 1,500 corridors (Shufon & Adams, 2003).

$$TEUC_c = \sum_{l \in c} TEUC_l \dots \dots \dots \text{equation 4}$$

Ultimately, the system uses benefit-cost ratios in measuring the performance of each project. Since a reduction in user cost is considered a benefit, and the cost is agency expenditure to apply a treatment (converted into annualized costs), models are used that are capable of converting system condition such as pavement condition (IRI) to cost savings to assess the benefit of each treatment, and consequently estimate the B/C ratio as follows:

$$C_a = AC_a \times CRF_a$$

$C_a = \text{Annualized agency cost}$

$AC_a = \text{Annualized agency cost for treating asset } a$

$CRF_a$

$= \text{Capital Recovery Factor dependent on the service of treatment and discount rate}$

For analysis link  $l$

$$\left(\frac{B}{C}\right)_l = \frac{TEUC_l}{\sum_{a \in l} C_a}$$

For analysis of a corridor  $c$

$$\left(\frac{B}{C}\right)_c = \frac{TEUC_c}{\sum_{a \in c} C_a}$$

The literature revealed less agencies performing network-level value-tradeoff analysis compared with the survey results. The difference may be attributed to the fast-changing TAM environment. In addition, although the literature suggested some specific agencies were conducting cross-asset value-tradeoff analysis, the interviews revealed otherwise.

## 6. Moving Forward: GDOT

Data integration is one of the critical prerequisites for performing cross-asset value tradeoff analysis. True excellence in network-level value tradeoff analysis is possible if an agency ensures a good communication between departments and, consequently, their infrastructure management systems. This process leads to data sharing, reduction in redundant data collection as well as more effective use of resources, all leading to a better

asset management practice. Value tradeoff analysis capabilities may be developed from existing management systems with a good understanding of the data flows within the agency, i.e., where the data that feeds into these systems come from, the method by which they are gathered and the frequency with which they are updated, and how the data is used in making decision., as well as a good understanding of the referencing system. The next few sections discuss GDOT's present capabilities in asset management and how they may be harnessed to conduct value tradeoff analysis.

### 5.1 The Computerized Pavement Condition Evaluation System (COPACES)

COPACES gathers pavement condition data for all state-owned roadways (asphalt and concrete), and uses this data to evaluate and rate the condition of every mile of roadway. The system, which is used by area and district maintenance offices and the office of materials and research, also determines the needed maintenance activities (i.e., crack sealing or resurfacing) as well as the cost of such activities and predicts the future condition of roadway (i.e., LOS of roadway) for a specified funding level.

### 5.2 The Bridge Information Management System (BIMS)

The system uses input data (inspection data, which is updated every 2 years) from bridge inspection and rates the condition of bridges on a scale of 0-9 based on a priority formula. The information generated by this system is used by the bridge maintenance unit, the office of transportation data, and by the upper management for the purposes of planning. The results also feed into the Federally-required NBI program.

### 5.3 Highway Safety Management System

GDOT's HSMS is a comprehensive database capable of storing detailed information about State DOT signs. The system, built by a contractor, is fully developed but not populated with data. However, GDOT planned to begin data population by the mid fiscal-year of 2011, and have the system in place by January 2012. Currently, the system is fully developed and being populated with data.

## **7. Requirement Assessment for Data Integration**

The Data Integration Primer developed by the Federal Highway Administration's Office of Asset Management indicates that requirements analysis is the first and most essential stage of data integration (2001). That is, an agency considering data integration may first identify the requirements for an integrated data system. Although this process can be complicated, in the end, the agency may try to address the following: the business process that the system will support; the data that will be shared, the goals the agency is trying to accomplish, and the constraints or challenges that are expected to impact the process (USDOT, 2001).

The previous sections articulate some of the business processes supported by some of the individual systems currently maintained by GDOT. Since the users of these individual systems will eventually share data from the integrated system, it is important to consider

their inputs and requirements in the design process. In order for GDOT to accomplish their goals of assessing tradeoff among these systems, they must overcome the constraints and challenges that exist in within the organization. On way to successfully gain the support of individual users and overcome organizational barriers and break the issue of autonomy is to involve all the data users within the organization, and incorporate their requirements in the process.

## **8. Potential to Apply Network-level Value Tradeoff at GDOT**

One of the multi-objective optimization solution seeking strategies previously discussed may be applied to conduct tradeoff analysis using the GDOT infrastructure management systems. The goal-programming method may be used to capture the agency’s strategic plan objective, determine a Pareto efficient solution to the multi objective problem, and assess tradeoffs. The method is relatively easy to implement. With this methodology, the agency can use performance targets as soft constraints to assess the tradeoffs among programs by examining how much each goal deviates from its respective target upon shifting funds among program areas. In essence, the decision maker’s decision will be based on the absolute magnitude of deviation from the target. Basically, the decision maker will have selected the best portfolio if the multi-objective function is minimized, as illustrated in equation 3.

$$U_{A_i} = \min(\sum_{j=1}^n w_j |a_j - b_j|) \quad i = 1, 2, \dots, m \dots \dots \dots \text{Equation 3}$$

Where  $w_j$  = weight of program area  $j$

$U_{A_i}$  = Expected utility for asset/program  $A_i$

$a_j$  = scaled target of performance for asset/program  $j$

$b_j$  = actual scaled performance for asset/program  $j$

$n$  and  $m$  are the number of goal targets and alternatives, respectively.

The input data for this objective problem can be generated from the program areas’ management systems. These systems have the capability to predict the performance of the system for every given budget scenario. The system goals are already established by GDOT through policy guidance. On the other hand, program weights can be established by the same procedure or through a survey of decision makers as well as system users to ascertain a compromised relative weight for each program area. The output data can be evaluated as individual deviation from each goal, or as a resultant value for the entire network that can be visualized by the decision maker. Using data from the integrated system, in addition to the use of engineering judgment, decision makers can then conduct well-informed tradeoff analysis in allocating resources.

### 7.1 Visualized Illustration

Consider three objectives, each with their goal deviation from their respective targets represented by an axis in Figure 3. If each point within the solution space represents a simulation of the performance outcomes with different budget allocations among program areas, i.e., X%, Y%, and Z% of agency’s overall-budget to safety, mobility, and preservation, respectively, then the scenario closets to the origin (0,0,0) will represent the most efficient point among the rest.

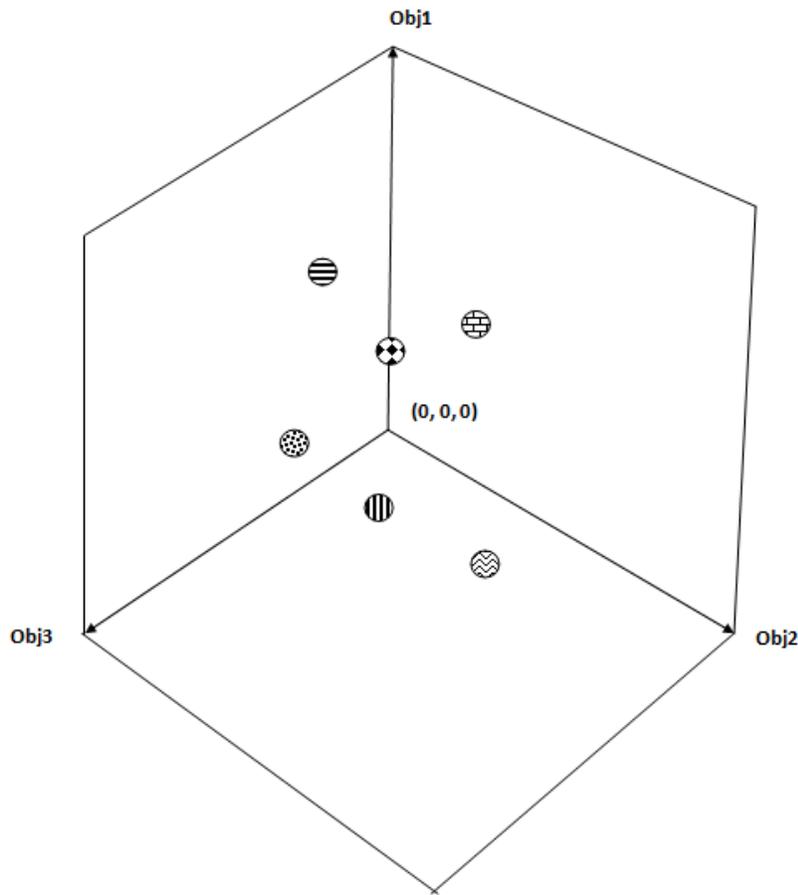


Figure 3: Visualization of Simulations in Solution Space for Tradeoff Analysis

## 9. Conclusions

This study assesses approaches for conducting value tradeoff analysis, investigates the practice of network-level value-tradeoff analysis among DOTs, and offers a simple methodology that may be used to conduct value tradeoff analysis using GDOT’s management systems. First, the study conducted a literature review on current research and applications of value tradeoff analysis. Second, we conducted a survey of all state DOTs to determine applications of value tradeoff analysis in state DOTs. The survey had a 41% response rate. The literature reviewed, in addition to the survey, revealed limited work has been completed in network-level value tradeoff analysis in the area of

transportation asset management although more and more agencies are showing progressive interest in securing enabling tools. The survey also revealed that one area of concern to decision makers and asset managers is the inability to establish a common measure for tradeoff analysis. More extensive completed work in analyzing value tradeoffs was found in the field of Operations Research. Some of the strategies in seeking solutions to multi objective tradeoff analysis have been presented and their applicability to TAM presented. In addition, the study reviews infrastructure management systems at GDOT, assesses requirements for data integration and approaches for determining Pareto efficient points in a decision space for use in value tradeoff assessment, and articulates how GDOT may apply these principles with their existing management systems to make value-tradeoff assessments. The study emphasizes that agencies develop value tradeoff analysis capabilities by understanding their own objectives, knowing the systems they have, and simulating investment scenarios that allow pare to efficient ones to be identified and tradeoffs assessed in allocating resources.

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